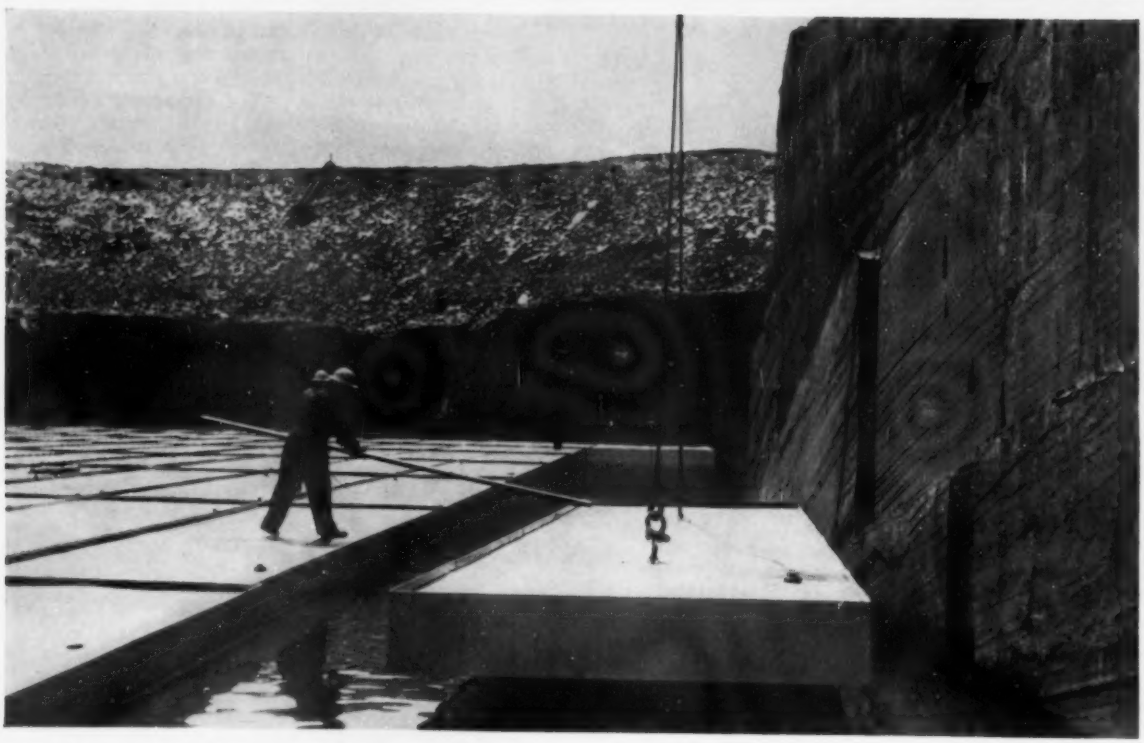
PETROLEUM PROCESSING

including Petrochemical Processing Section

OCTOBER 1954



Over An Acre of 'Floating Roof' on quarry oil storage tank . . . p. 1583.

Smog-Fighting Is Costly

West Coast refiners will have spent over $25 million by May—p. 1567

How Much Can a Pump Pump?

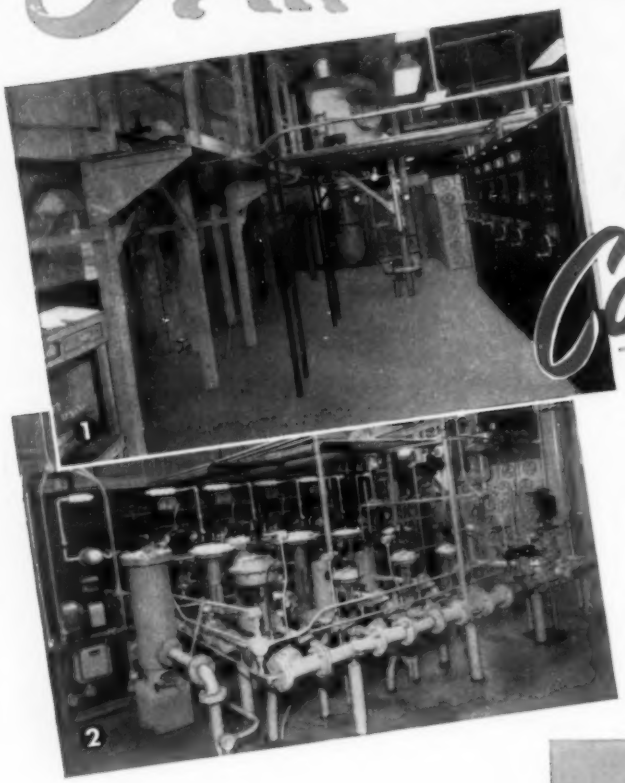
A new approach to figuring capacity—limiting entering head—p. 1576

A McGRAW-HILL PUBLICATION

SINCLAIR *INCREASES OUTPUT...*

...with % PROPORTIONEERS %

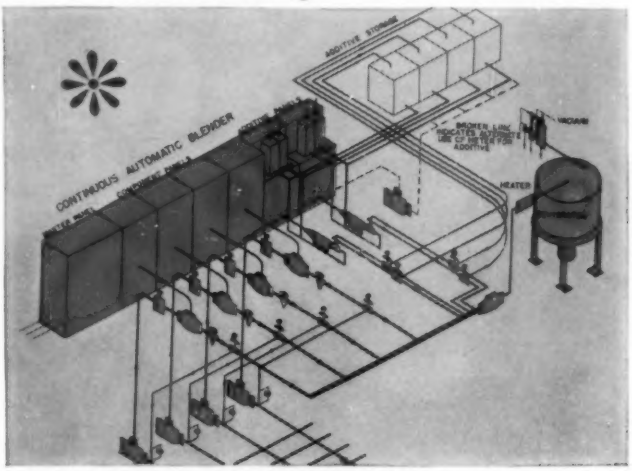
Automatic Compounding



This new %Proportioneers% installation at the Marcus Hook plant of Sinclair Refining Company utilizes phase control between components of lube stocks to reduce batch blending to completely automatic compounding. %Proportioneers% recirculation method permits exact presetting and control of component and additive ratios and allows quick adjustment of the total rate to production requirements without affecting these ratios. %Proportioneers% Continuous, Automatic Compounding makes possible greater flexibility between small and large quantity production with increased operating efficiency and new economies in material handling.

❶ %Proportioneers% compounding panels at right, additive storage upper left, and flash evaporator in background.

❷ Back side of compounding panels showing control valves, recirculation system, and blend manifold.



✳ **All equipment shown red in flowgram furnished by %Proportioneers, Inc.%**

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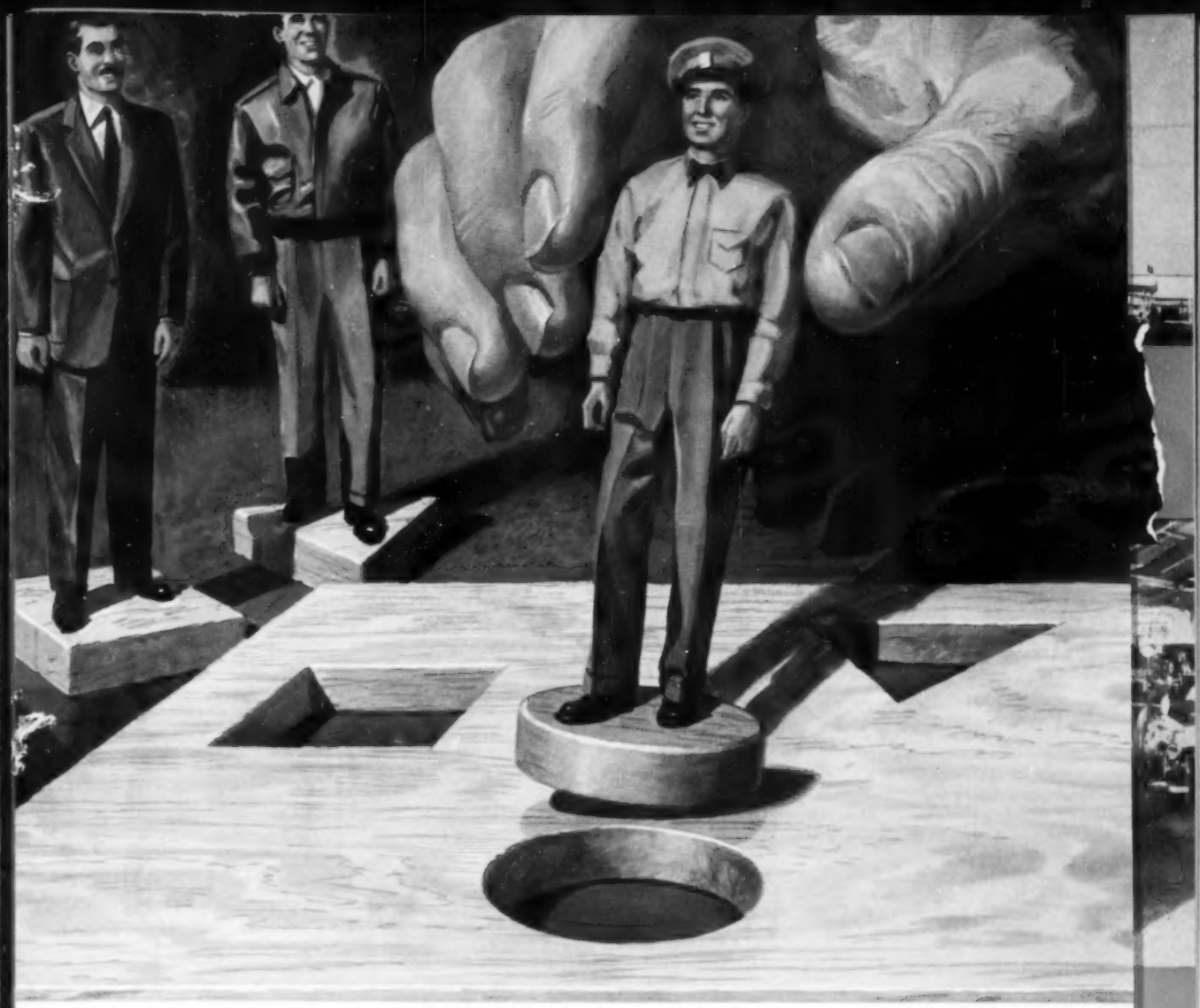

Helping dealers to find the right man

Have you heard about the new program to attract and keep better-quality men in service-station jobs?

It's a new Ethyl service.

Called Ethyl's Recruiting and Training program, it will, we believe, be a valuable supplement to the work of individual oil companies, and the committees of the API and other associations which are concerned with this problem. Here, in brief, is the story.

First, to get the complete national picture, we asked more than 4,500 dealers employing more than 15,000 attendants to tell us about their personnel problems. Nearly all reported they had difficulties in recruiting, hiring and training their people. So much so, that nearly half of those hired left because they were "unsatisfactory," and nearly

(*Continued on next page*)

ETHYL
ANTIKNOCK COMPOUND
ETHYL CORPORATION

Printed in U. S. A.

Helping dealers to find the right man

(*Continued from preceding page*)

60% of the men working as attendants had experience of only one year or less.

So we sat down with vocational-guidance people and men from the petroleum industry and worked out our new R. T. (Recruiting and Training) program.

We reasoned, after a good deal of study, that if more people knew of the fine opportunities available in service-station employment, better men would be interested. So a film, booklets, and special kits were created to take this message to young men and their families.

And to help bring these better recruits along, Ethyl's dealer-training materials and services are being enlarged and streamlined.

We hope this new Ethyl service can help your dealers build a better and more stable service-station sales force. Our prime objective is to help the industry in one of its more vulnerable areas: the front door of its business.

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WORTH NOTING

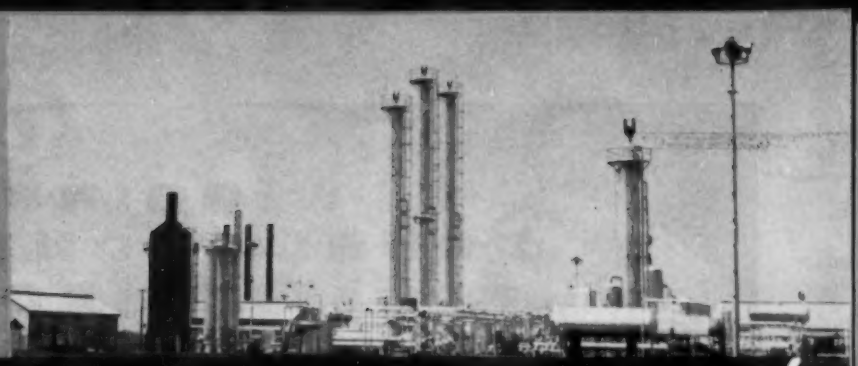
One of the first demonstrations of the superiority of "Ethyl" gasoline occurred at the 1924 Indianapolis Memorial Day Race. Out of a field of twenty-one, the seven cars fueled with gasoline containing "Ethyl" antiknock compound won the first seven places.

The portable lead-in-air analyzer, now considered one of the petroleum industry's most important safety tools, was developed and first produced by Ethyl Corporation.

One teaspoon of "Ethyl" antiknock compound can raise a gallon of gasoline as much as 10 research octane numbers.

Ethyl Service is backed by 31 years of antiknock experience

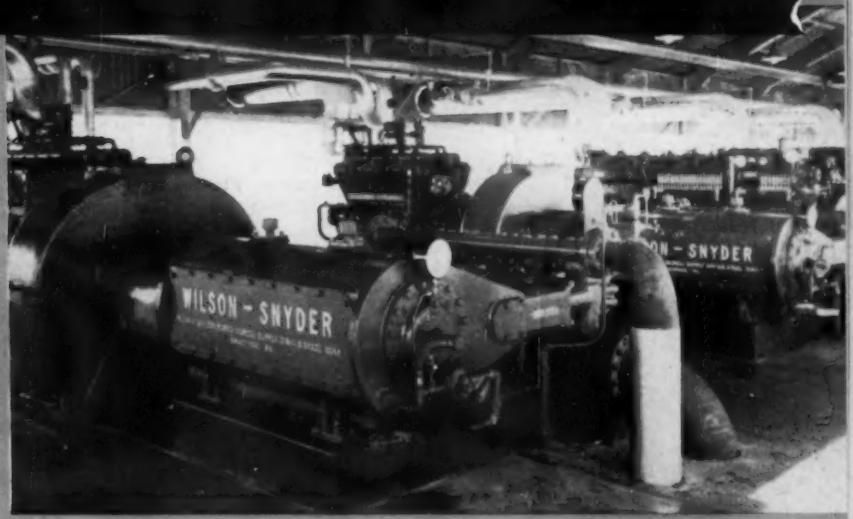
In the R. R. Dean Processing Plant near Agua Dulce, Texas



Quintuplex Plunger Pumps

. . . recycle lean oil in the absorption process at

HIGH PRESSURE



ENGINEERING, design, and construction of this plant were performed by O. L. Olsen Company of Houston, Texas for the Tennessee Production Company.

It was designed to process 100,000,000 cubic feet of gas per day, "floating" on Tennessee Gas Transmission Company's line pressure of 800 pounds; total plant pressure drop 8 pounds.

In the absorption process, two No. 558-P Wilson-Snyder Quintuplex Plunger Pumps recycle lean oil after it is refrigerated to 50 degrees F. Equipped with hardened steel plungers, heat-treated stainless-steel wing-guided valves and seats and driven through speed reducers by 340-hp Le Roi gas engines, each pump is capable of delivering 510 gpm at 1270 psi.

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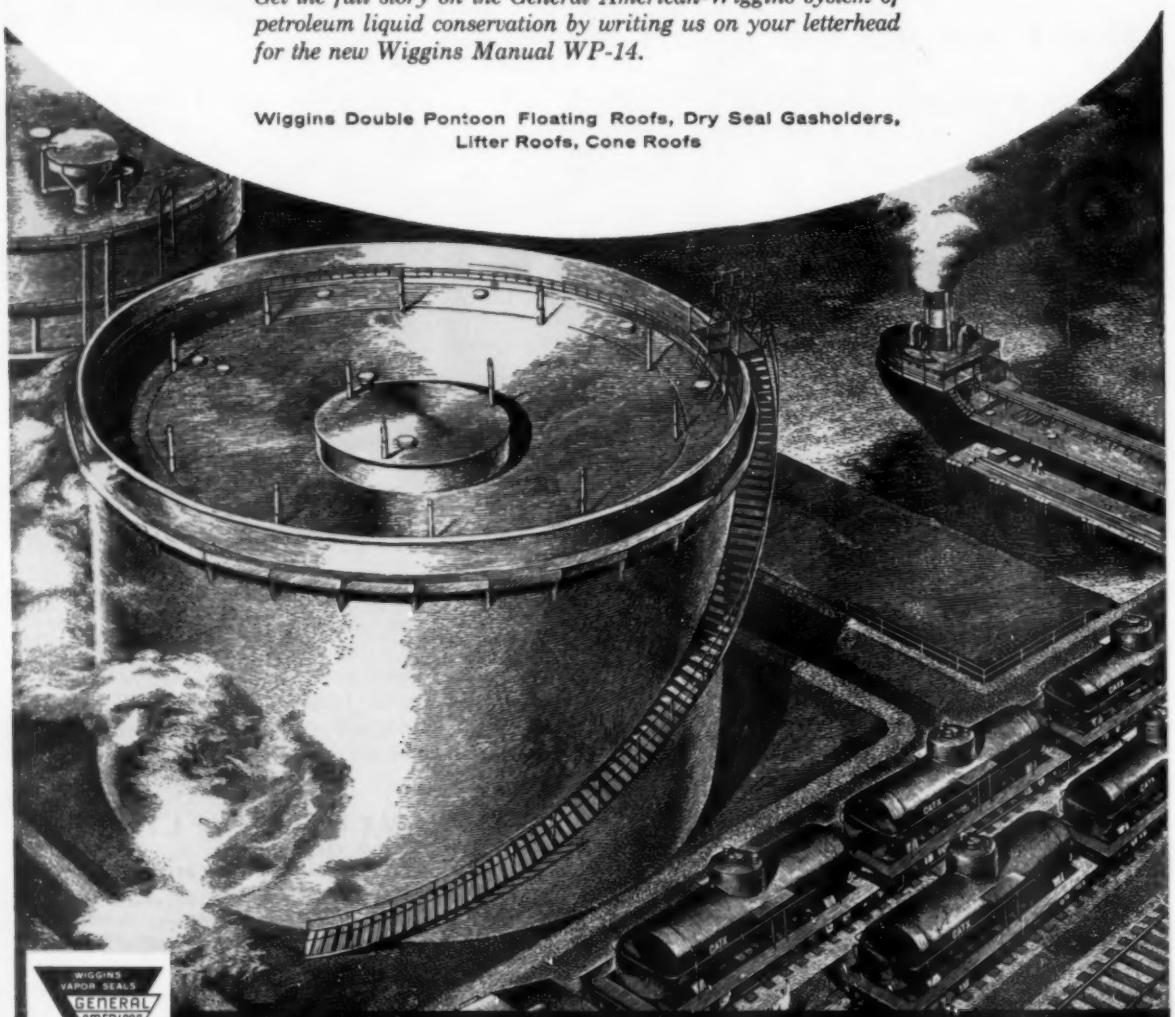

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PETROLEUM PROCESSING

Covering petroleum and petrochemical research and the design, construction, management, operation and maintenance of plants processing hydrocarbon materials into fuels lubricants and chemicals.

October, 1954
Vol. 9, No. 10

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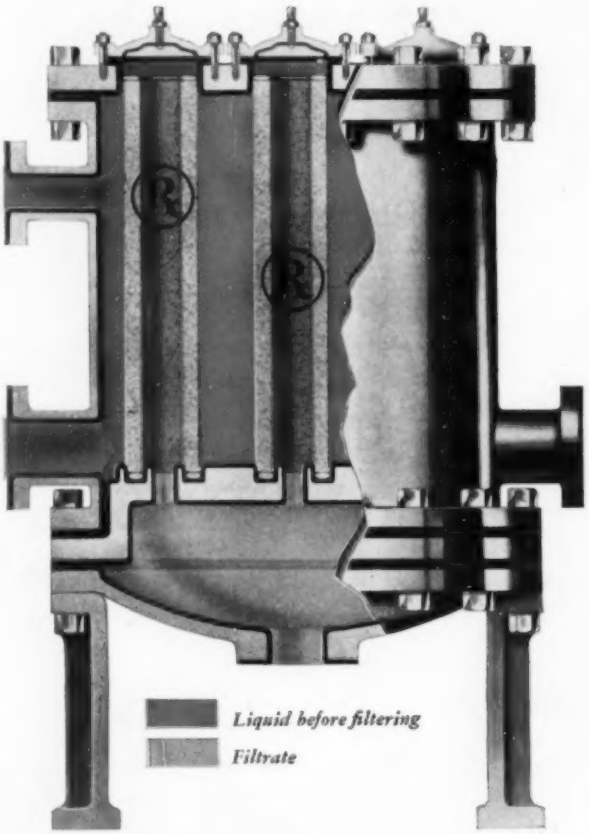

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(To obtain more data on advertised products see page 1620)

PETROLEUM PROCESSING

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Meet Our New M.E. — Bill Uhl

MANY of you know Bill Uhl of our editorial staff. He's been in practically every petroleum processing plant east of the Mississippi—plus a good many to the west, and he regularly attends a dozen or so industry meetings each year.

Well, Bill has a new job. He is now Managing Editor for PETROLEUM PROCESSING, filling the spot I vacated earlier this year. If any of Bill's friends in the industry are acquainted with the usual type of managing editor they are probably sadly shaking their heads, saying "I knew him when . . . " and conjuring up visions of him sitting at a desk for the balance of his editorial life.

Fortunately for us—and Bill—that isn't the concept we hold of a managing editor's job. The way we look at it, Bill's job is to see to it that the magazine gets out each month. But in getting the magazine out, he has to see that the material it contains is presented in such a way that it will be of the highest possible value and interest to you. We don't think a managing editor can do his job properly if he's a "desk jockey." We think he must maintain continuous close contact with the industry, to know what its current problems are and what its thinking is, so he can do an intelligent job of putting the magazine together. For those reasons, you'll still be seeing a lot of Bill out in the field and at various meetings.

By way of giving you a little background on Bill, his legal name is William Christian Uhl, he's 40 years old, married, has three children (Christina, Catherine and Kenneth), and lives in White Plains, N. Y. He was graduated from Fenn College with a B.S. in Chemical Engineering in 1937, and went to work as a chemist in the plant control laboratory for Gibson-Homans, a paint specialties manufacturer in Cleveland. In 1940 he joined the Lubrizol Corp., lube oil additives manufacturer, as a pilot plant engineer.

Lubrizol must also have made some printing ink additives, because it was while he was with them that Bill got seriously interested in technical editorial work. He did an article on safety in the small plant, which we published in the old *NPN Technical Section;* as Bill recalls, "you paid me for it, too!" After a year with an industrial publications service firm, he joined our editorial staff in July of 1946—just in time to help us put out the last issue of the *NPN Technical Section*. But then we started publishing PETROLEUM PROCESSING—and Bill's been moving right along with that magazine ever since.

William F. Bland

Editor

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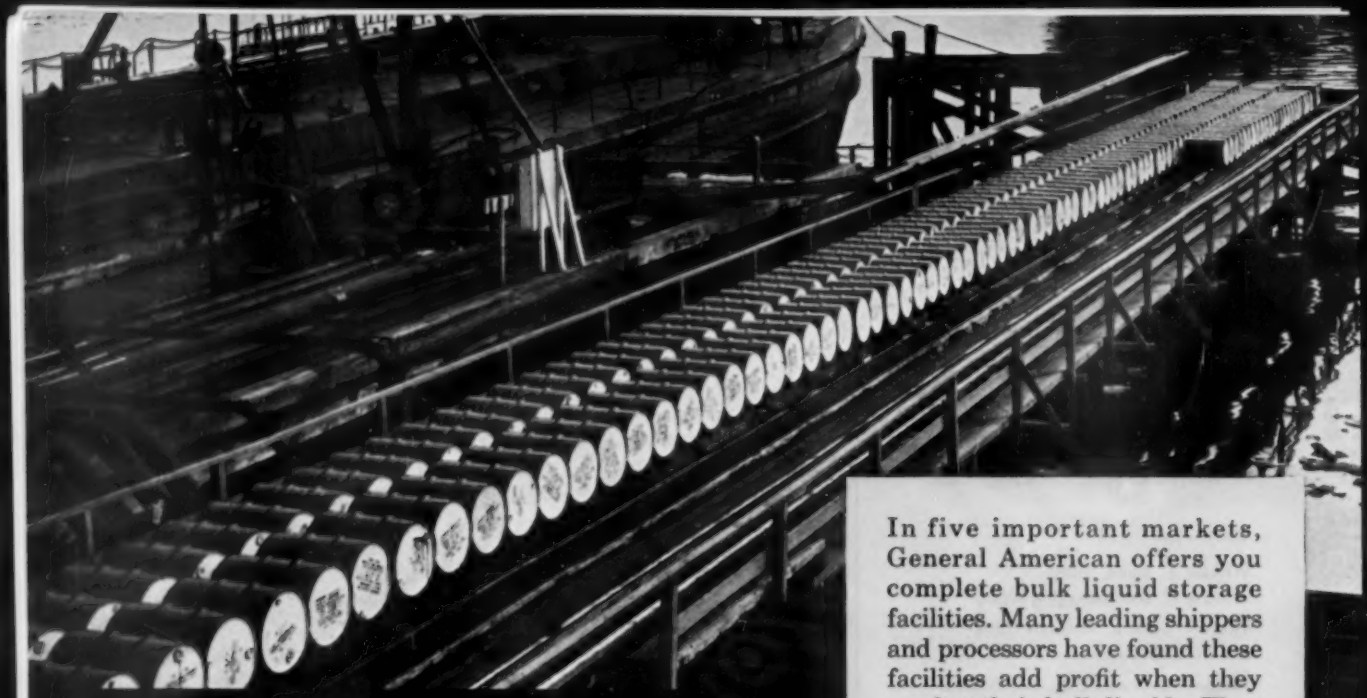

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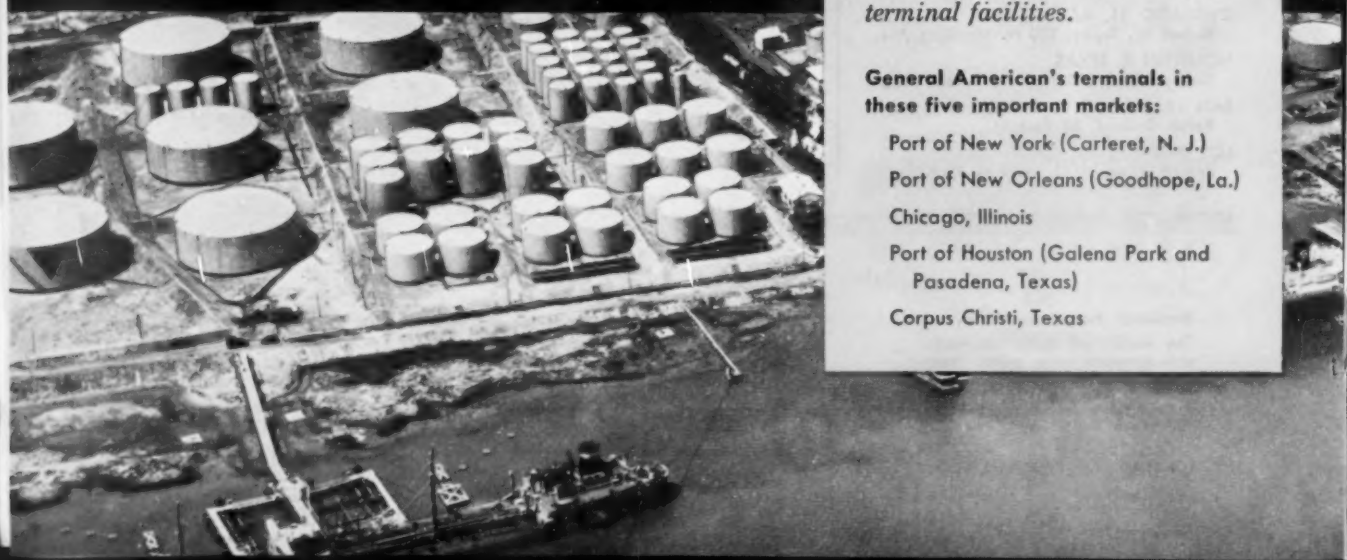
- Corpus Christi, Texas



What's Happening...

in Refining

. . . **Fast tax write-off program may soon end** as a result of Oil and Gas Div. survey to determine whether continuation is now necessary with revisions resulting from new Tax Law. Possible exception would be outright military projects. (For details on how new law can help see pp. 1574-75, this issue.)

Defense officials have already decided against extending fast tax write-off approvals on plant modernizations which do not include plant expansion.

. . . **Aurora Gasoline Co.** has awarded contracts for new facilities at Detroit, Mich., refinery. Procon, Inc., will build a new 14,000 b/d Fluid cat cracker, doubling present cat cracking capacity. Ralph M. Parsons Co. will build a Standard Oil Development Co. licensed, 4000 b/d (100 ton/day of coke) Fluid coking unit; a UOP and Union Oil of Calif. licensed, 7500 b/d Unifiner (using hydrogen from Aurora's 6000 b/d Platformer); and a Parsons-designed, 30 ton/day sulfur unit, using amine treating to remove hydrogen sulfide from the Unifiner product gas. Completion is expected in early fall, 1955.

. . . **Plans for at least two new refineries** in New Mexico and Arizona and a 900-mile crude oil line from the Williston Basin to that region were indicated in three related applications for fast tax write-off filed at ODM.

Proposed pipeline from southeast Wyoming to Albuquerque, N. M. and then to Phoenix-Tucson are at an estimated cost of $31,000,000, would have 20,000 b/d capacity at start and 30,000 b/d max. 6 months later. Firm application was made by Ar-Mex Pipeline Co.

Refineries are: Navajo Refining Co.'s plan for a 10,000 b/d, $10,000,000 plant at Albuquerque; and Arizona Refining Co.'s plan for a 15,000 b/d, $12,000,000 plant at Phoenix. Another is being considered for Colorado Springs, Colo. Companies said some aviation gasoline would be refined.

. . . **Danaho Refining Co.** has obtained Office of Defense Mobilization approval for fast tax write-off on a 1000 b/d UOP Platforming unit at its Pettus, Texas, refinery, for $250,000.

. . . **Standard Oil Co. (Indiana)** has awarded Ralph M. Parsons Co. prime contract for a new 14,000 b/d Ultraforming unit at Sugar Creek, Mo. Construction is expected to be finished by mid-August, 1955.

. . . **Tide Water Associated Oil Co.'s** projected new refinery for the Delaware Valley (exact site not yet disclosed) may be 130,000 instead of originally planned 100,000 b/d capacity.

. . . **Bay Petroleum Corp.** will build a 1500 b/d catalytic reforming unit at Chalmette, La., and move its topping and cracking unit from McPherson, Kans. to the Chalmette refinery. Estimated cost of $1,158,325 has received fast tax write-off approval.

. . . **Humble Oil & Refining Co.** has received fast tax write-off approval on additions to hydroformer and related equipment at Baytown, Texas, for $805,000.

. . . **North Star Oil Ltd.** is building a new 12,000 b/d refinery at St. Boniface, Manitoba, comprising an Orthoflow cracking unit, poly plant, gas concentration. The construction contract has been let to Canadian Kellogg Co. Ltd.

in Petrochemicals

. . . **Northwest Nitro-Chemicals Ltd.,** a new company, will operate British Dominion Co.'s new $18 to $20,000,000, gas-to-chemical-fertilizer plant in southern Alberta, for which plans are nearing completion. Principals in Northwest Nitro are Bacon-Davis, a New York engineering firm, and Frank McMahon, Calgary. McMahon is president, Westcoast Transmission, and chairman, Pacific Petroleum.

. . . **Standard Oil Co. (Ohio)** has selected Lima, Ohio, as site for its new $17,000,000 ammonia chemicals unit. M. W. Kellogg Co. will build anhydrous ammonia, nitric acid and ammonia solution plants. Urea plant contract has been awarded to Arthur G. McKee Co., who will also do office building, laboratory, and related facilities.

. . . **Sinclair Chemicals Co.** has negotiated a license agreement with Universal Oil Products for a 2300 b/d Udex unit at Marcus Hook, Pa. To operate on feed from new catalytic reformer now being completed, entire petrochemical operation will produce 18,000,000 gal/yr of aromatics, including toluene, xylenes, and paraxylene. Badger has construction contract for Udex unit as well as for installation of 10,000,000 gal/yr paraxylene unit.

. . . **Cooperative Farm Chemicals Association's** new ammonia plant at Lawrence, Kans., was reported as having been designed and built by Girdler Corp. in these pages last month. This was an error. Contractor was Foster Wheeler Corp.; however an ammonium nitrate and nitrogen processing unit at Lawrence was designed and built by Girdler.

in Foreign Operations

. . . **Plans for a synthetic rubber-from-petroleum plant** in France are in discussion stage. If company is formed, Esso Standard S.A.F. will take lead, along with the government-owned Compagnie Francaise de Raffinage, and associated with eight rubber and chemical firms;

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

Michelin, Dunlop, Kleber-Colombes, Kuhlmann, Rhone-Poulenc, Pechiney Ugine, and Bozel-Maletra. Plant capacity would be 20,000 ton/yr. and investment between $20 and $25,000,000.

. . . **Commonwealth Oil Refining Co.** has made licensing arrangements with Houdry Process Corp. for construction of a 26,800 b/d Houdriflow cat cracker and a 3730 b/d Houdriformer at a $24,500,000 refinery to be built near Ponce, Puerto Rico. Complete refinery, to be built by the Lummus Co., will have 23,000 b/d capacity, and is expected to reach operation by the end of 1955.

. . . **Royal Dutch/Shell Group's** refinery at Pernis, the Netherlands, will build a second Fluid type catalytic cracking unit, of about 35,000 b/d capacity. Completion is expected in about two years. Operating company is N. V. de Bataafsche Petroleum Maatschappij.

in Transition

. . . **Pan American Petroleum & Transport Co.,** formerly eastern subsidiary, has been merged with parent firm, Standard Oil Co. (Indiana). At same time, American Oil Co., previously marketing company, was made an integrated firm, with its own production, refining, and transportation facilities.

As a result, Amoco will operate refineries at Baltimore and Savannah, as well as now-building 35,000 refinery near Yorktown, Va. In addition, it will market output of Pan American Refining Corp. plant at Texas City.

Affiliates dissolved and taken over by American include: Pan American Refining Corp. of Del., Mexican Petroleum Corp. and Mexican Petroleum Corp. of Ga., plus marketing groups.

. . . **Derby Oil Co.** has reached substantial agreement on plans for merging into Colorado Oil & Gas Corp. with stockholders' approval expected by about Oct. 15. No changes in refining and marketing policies is contemplated after the merger. Derby has a 15,000 b/d, newly modernized refinery at Wichita, Kans.

. . . **Shallow Water Refining Co.** has closed its 5000 b/d refinery at Garden City, Kans., for at least two months, because of economic problems. If in study now being made, decision is reached to permanently cease operations, plant will be offered for sale.

. . . **Synthetic fuels work will be split** under Bureau of Mines reorganization: coal-to-oil activities going to Solid Fuels Div., and oil shale to newly-created Petroleum and Natural Gas Div.

. . . **Premier Oil Refining Co.** is consolidating its east Texas refining operations at the Longview plant. This means increasing crude run at Longview and subsequent closing of the refinery at Arp. Also, company will cut off out-of-state gasoline shipments.

in Labor and Law

. . . **Move to "big" union got "big" lift** last month when United Gas, Coke, and Chemical Workers voted approval by about 2 to 1 margin for merger with Oil Workers International Union. This adds about 84,000 members to OWIU's own 90,000 membership, a hefty step toward all-out organization of oil and chemical industries.

OWIU itself must still approve merger at its own convention Nov. 15, but this Knight group has been spearhead of movement so approval is seen as merely formality. CIO President Walter Reuther pledged full help from parent organization in form of funds and personnel for any drive the two unions may plan.

. . . **Suit to force lube oil re-refiners** to pay 6¢/gal Federal excise tax has been filed in Washington Federal District court by Barkow Petroleum Co., Los Angeles, a California refiner.

Suit asks mandatory injunction directing Internal Revenue Service to collect taxes and signalled end of long effort to get Internal Revenue to do so by voluntary administrative act. Government has 60 days to answer complaint.

Estimates of re-refiners' cut of lube market run up to 75,000,000 gal/yr, representing $4,500,000 in potential excise levies.

in Markets and Prices

. . . **The rise in refined products prices** caused by midsummer cutbacks in refinery runs showed signs of stalling in September. Crude throughput at refineries crept back close to the 7,000,000 b/d mark. And with increased output, product supply loosened, demand tapered off.

. . . **In Pennsylvania,** South Penn Oil cut its posted price 3 to 5¢/bbl. in three producing districts. Reductions in pipe line gathering tariffs made necessary "adjustment" of crude prices to maintain delivered costs to refineries in middle district (Penna.) competitive, South Penn said.

. . . **Esso Export Corp. slashed its avgas prices** 0.5 to 0.7@/gal. to new FOB Aruba, N.W.I., postings of 18.25¢ for Grade 115/145; 16.75¢ for Grade 100/130, and 15.25¢ for Grade 91/98. Avgas prices at the U. S. Gulf, however, were unchanged.

. . . **In midwest wholesale gasoline markets,** discounts of as much as 0.625¢/gal from quoted prices continued to rule. Prices were steady at the Gulf and along the Eastern Seaboard. But it was a different story at the retail level. Gallonage flights continued to plague New England, Texas, and other points.

. . . **On the bright side** of September markets there was a 0.5¢/gal. increase in Grade 26/70 natural gasoline prices, to 5¢ Group 3, and 4.5¢ FOB Breckenridge, Tex. There was also a 5¢ boost, to $1.15/bbl. in Group 3 prices for heavy fuel.

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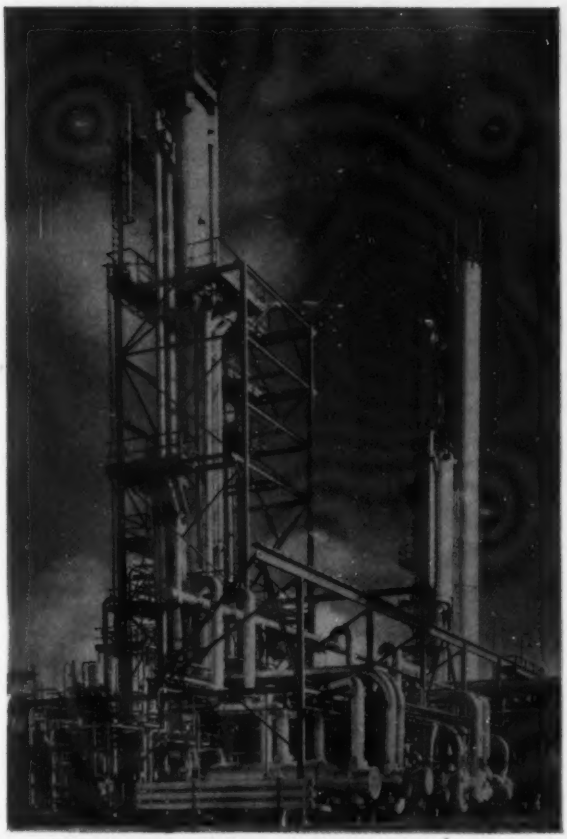
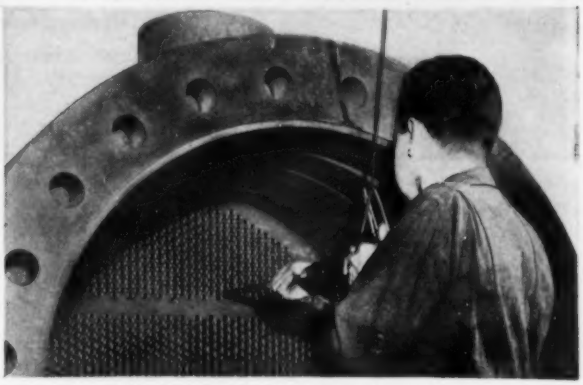


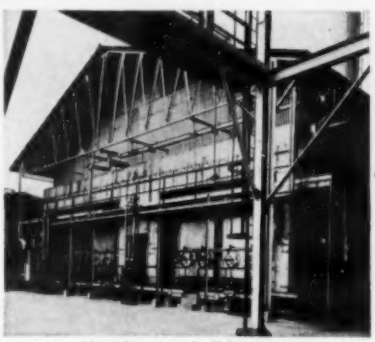
Engineering and construction of chemical and petrochemical plants

Engineering and construction of petroleum refineries



Manufacture of heat transfer equipment
(Heat Exchanger Division)

Shop fabrication and installation of pressure piping
(Fabricated Piping Division)



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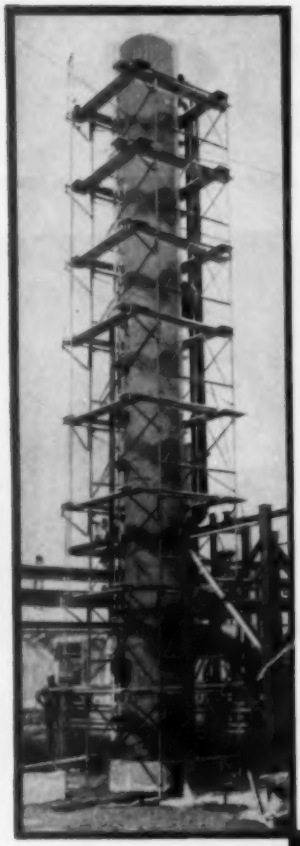

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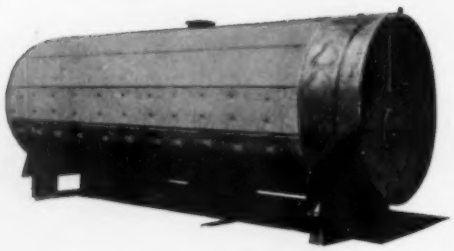
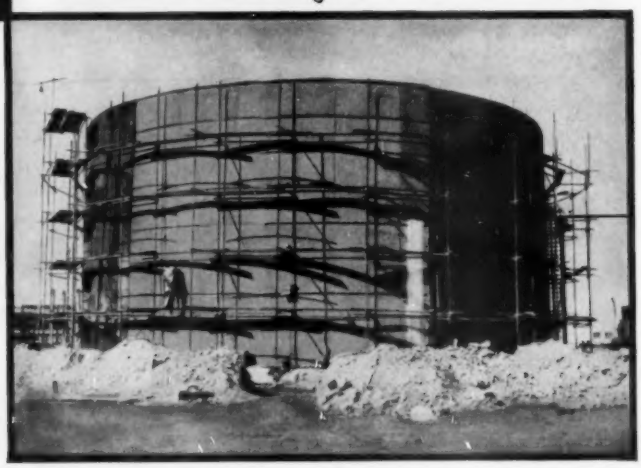
ULTRALITE

the long glass fiber insulation





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Competition from Shale Liquids Outside the Gasoline Field?

As long as intensive work is being carried on in the appraisal of product quality and utilization, there remains the possibility that the first commercial liquid products from oil shale and from coal to compete with the petroleum refinery output may be something other than motor fuel.

Although the development of large commercial sources for synthetic gasoline has been the chief aim of the work by the government and the oil companies in synthetic liquid fuels research, all materials coming from the reaction vessels have been subjected to testing and analysis.

A case in point is the research project sponsored by the American Gas Association at the Institute of Gas Technology in Chicago on the production of high-Btu gases from crude shale oil.

A recent progress report indicates the interest of the gas utilities is not primarily on product superiority as compared with the materials for gas manufacture that refiners turn out.(1) Rather, the emphasis is on the economic possibilities of using—in certain areas—oil extracted from shale to make gas for the periodic peak demands that cannot be met with pipeline gas.

Looking ahead, the gas utilities see the Dieselization of the railroads, the development of jet aircraft, and the growing heating oil market as providing markets which can outbid them for the straight-run distillate oils for gas manufacture.

Even the supply of low grade residuals for this purpose seems threatened, they believe, because of the petroleum refiners' efforts to convert these oils to more profitable products.

Rising prices are foreseen by the gas companies for all petroleum products, due basically to the higher costs of finding new crude fields, which adds to the price of crude oil.

A definite advantage, on the other hand, is seen by the utilities in the switch by West Coast gas companies to shale oil for their needs. The shales in Colorado, Utah, and Wyoming provide a known reserve running into hundreds of billions of barrels. More importantly, the cost of extracting oil from the shale can remain stable for years ahead, they believe, and the rate of production can be fixed as desired.

An average cost of $2.65/bbl for partially refined shale oil in Los Angeles can be seen on the basis of 1951 prices, using the new shale retorting processes which have been developed, according to the AGA report.

"If the cost of domestic crude production continues to increase," the report goes on, "differences between the cost of petroleum products of interest to the gas industry and similar products derived from shale oil may cease to exist in some areas within the foreseeable future."

The loss, at present, to oil companies of this oil-for-gas business in geographical territories where oil from shale could be distributed would not be great. Only a relatively small volume of the refiner's output goes to this market.

However, the degree of competition could become a bit different if these shale products became the principal ones and the naphtha and motor gasoline became by-products. —V. B. G.

(1) "Production of High-Btu Oil Gases from Crude Shale Oils," E. B. Schultz, Jr., J. J. Guyer, and H. R. Linden, Institute of Gas Technology, Chicago, Ill.

Study of Aircraft Gas Turbine Needs Will Speed Use of Synthetic Lubes

THE search for satisfactory lubricating oils for aircraft gas turbines by a few refiners and other interests had definitely turned in the direction of synthetic oils. Intensive study of the characteristics of these materials for this use is also seen paving the way for their wider application where performance requirements are not so severe as with jet aircraft. For example, they may find use in the higher speed piston engines that will be coming along in a few years, and in gas turbine engines in automobiles, when these are introduced to the public. Possibilities are also seen for their use in some high-temperature industrial applications.

The types of synthetic oils which have been studied, primarily for service in aviation gas turbines, in the laboratories of Esso Standard Oil Co. are described in a recent report.(1) Principal attention has been given to the diesters, silicones, silicate esters, polyglycol ethers and phosphate esters. Diesters were selected as the best class of product to investigate further since their rating was uniformly good for load-carrying qualities, volatility, high-temperature oxidation stability and viscosity-temperature relationship, as shown in Table 1.

Noting the far larger cost of the synthetic lubes as compared with petroleum oils, the report states: "The most important task is to provide a suitable lubricant which will operate satisfactorily regardless of initial cost. If the oil does its job properly, its life and volatility will be such that the utility of a given charge of oil is considerably greater than that experienced with the conventional lubricants . . . Thus, relative maintenance costs can probably be made equivalent or even less with the synthetics." This same line of reasoning

Table 1—Properties of Lubricants

	Load Carrying	Volatility	High-Temp. Oxidation Stability	Viscosity-Temperature	Cost $/gal.
Petroleum Lubricants:					
Grade 1100	G	F	P	F	$0.75
Grade 1010	P	P	P	F	$0.55
Synthetic Lubricants:					
Diesters	G	G	G	G	$5-10
Silicones	P	G	E	E	$30-40
Silicate Esters	G	G	P	E	$10-12
Polyglycol Ethers	F	F	F	G	$2-6
Phosphate Esters	G	G	G	F	$4-12

E=Excellent; F=Fair; G=Good; P=Poor.

on costs might apply to other applications than for aircraft jet engines.

The present cost of the diester lubricants is several times that of petroleum oils for the same application. These costs will be reduced with volume manufacture. The diesters and other synthetic lubricants can be made from chemicals derived from petroleum or natural gas hydrocarbons, as well as from other sources. Their commercial manufacture will likely be largely from petrochemicals, because of the lower cost and availability of these materials. Thus the future may find refiners among the foremost manufacturers of synthetic lubricants. —V. B. G.

(1) "The Development of Synthetic Lubricants for Aircraft Gas Turbines," by D. W. Bedell, Esso Standard Oil Co., *Esso Air World*, July-August, 1954, pp. 10-15.

Progress in Separation Techniques Promising for Chemical Processes

RELATIVELY dormant recently, interest is being revived and petroleum technologists are continuing work on improved methods for separating hydrocarbons, both for laboratory analysis and for possible process use.

Among the techniques in which progress is being made are thermal diffusion, and selective solvent extraction. Reports on advances in these fields as well as in several others were made at the meeting last month of the American Chemical Society's Division of Petroleum Chemistry.(1)

Applications for thermal diffusion, as indicated in several papers in the symposium, include: separation of sulfur compounds from crude oil; concentration of lubricating oil additives; separation of organic liquids in rotary and packed fractionating columns; and fractionation of typical feed distillates into lube oil fractions.

In the field of solvent extraction, urea and thiourea complexes were reported as having uses in selective separation of pure normal paraffins, low pour-point lubes and fuels, higher octane gasoline and higher octane number Diesel fuels.

Another selective solvent approach receiving investigation was the use of oxy- and thiodipropionitriles for separating aromatic hydrocarbons in the C_6 to C_{10} range. These materials were reported to have superior performance to diethylene glycol in some systems.

Carbon dioxide has been seen as attractive because of low cost and unusual miscibility. Its use was studied in systems working with a co-solvent for increased extraction efficiency. Some 132 co-solvents were listed as pertinent to processes tested.

Another technique of interest in petrochemicals is selective solid compound formation (crystallization) with carbon tetrachloride for separating para from meta xylene. The carbon tetrachloride forms an equimolal, solid molecular compound with the para but not with meta nor with ortho xylene.

This permits increasing recovery of para xylene, it was said, because it is possible to exceed the limitations caused by eutectic formation with meta xylene.

Recoveries as high as 90% of the para are obtainable from typical cat reformer xylene cuts. The meta is then recoverable by fractional crystallization after para xylene separation.

It is thoroughly evident that petrochemical processing, like petroleum refining, is a field where techniques can become obsolete almost overnight. Demands for high purities, high yields, and high efficiencies are constantly being met by newer and better potential manufacturing methods. —W. C. U.

(1) "Symposium on Advances in Separations of Hydrocarbons and Related Compounds," sponsored by Division of Petroleum Chemistry and Division of Industrial and Engineering Chemistry, American Chemical Society, 126th National Meeting, New York City, Sept. 13, 14, 1954.

Tight Butylene Supply Could Lead to Dehydrogenation of Refinery Butanes

REFINERS may soon find themselves dehydrogenating refinery butane in order to get butylenes for alkylation if the octane race keeps on, instead of using as much butane as possible to produce volatility in their gasolines and selling the balance as liquefied refinery gas. Also, they may be looking for buyers of the butadiene which will be produced along with butylenes in the dehydrogenation step.

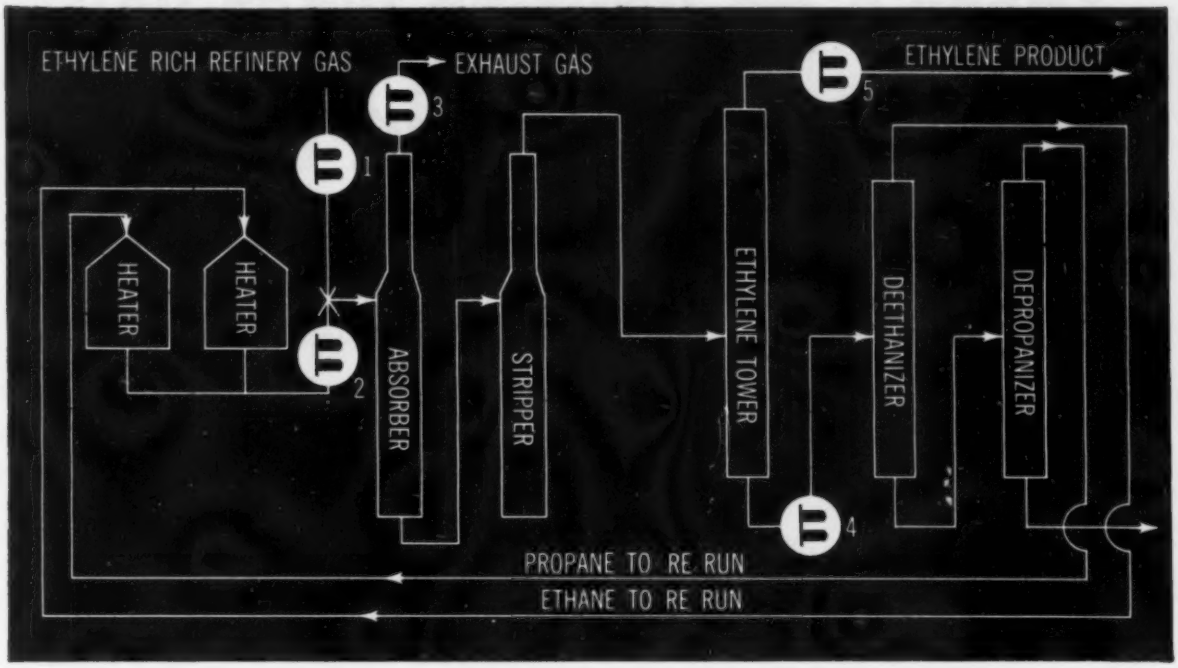
Butadiene plants and synthetic rubber manufacturers who make their own butadiene (or would like to) already are finding that refinery butylenes are expensive and closely held. In fact, this is probably the reasoning behind the promotion of a company (Texas Butadiene & Chemical Corp.) to make butadiene—and possibly alkylate—from purchased butane. The alkylate would absorb any excess of butylenes resulting from variations in butadiene demand, assuming, of course, that the plant would be under contract for a minimum volume of butane monthly.

Some refiners already are almost to the point where they have no surplus butylenes to speak of. (Proposals for some projected plants call for dehydrogenation units.) Also, it is not economically feasible to make more via catalytic cracking because this route effectively reduces the unit's capacity as a result of greater coke lay-down under maximum butylene-producing conditions.

The dehydrogenation processes available for converting butane to butylenes are the same as now in use in butadiene plants charging butylenes as raw material, although operating conditions will be somewhat different to favor butylene recovery and minimize butadiene production. However, these units still will need a solvent recovery system in order to remove the butadiene which will be produced, willy-nilly, and is undesirable in alkylation.

Butane also may become the raw material of choice in petrochemical plants now using propane as a starting point, because the latter's desirable physical characteristics make it an ideal fuel for mobile prime movers. This, LPG manufacturers believe, will ultimately drive the price of propane beyond what the petrochemical plants can afford to pay. At least one petrochemical plant is known to have based its initial designs upon butane principally because its economists made just this forecast several years ago. —D. P. T.

TRUE CONTROL BEGINS WITH ANALYSIS...



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Both the TRI-NON *and* BICHROMATOR Analyzer *continuously record the concentration of any desired stream component. Each is sensitized and adjusted to specific plant conditions before shipping.*

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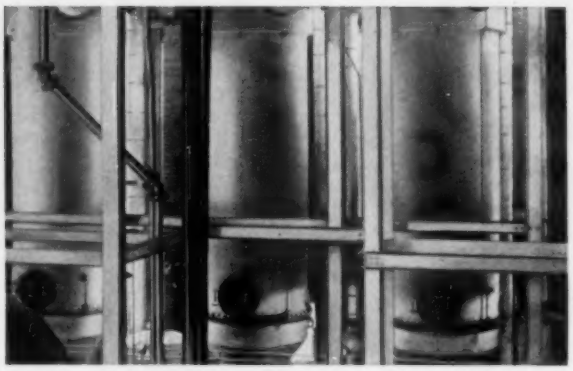

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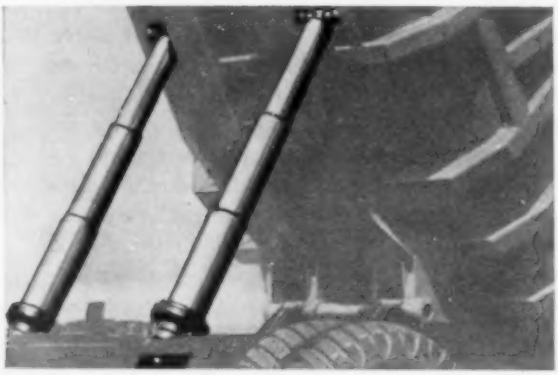

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GLOBE WELDING FITTINGS: seamless, carbon and stainless, available in a complete line of sizes and weights through Globe distributors in key cities.

Letters

Construction Costs

TO THE EDITOR: . . . I consider Mr. Fuller's paper ["Keep Construction Costs Down," August, pp. 1212-1215] to be one of the best ones I have ever read on the subject. The problems he describes are exactly the same as ours, and his suggestions for remedying them are very good . . . I am going to see that some of the operating personnel in this plant read it.

It sounds as if I had done nothing but jump on the band wagon, but I am not in disagreement with anything Mr. Fuller has written.

H. M. MARTIN
Chief Engineer
Eastern States Petroleum Co., Inc.
Houston, Texas

TO THE EDITOR: . . . We were very much interested in this article ["Keep Construction Costs Down"] and felt that the points raised by the author were sound. In the writer's own experiences, we have always insisted that no changes be made by operators in the field, but that they be routed through the proper channels. Also, the section (in the article) on rushing work without proper handling and expediting being a dangerous practice is a very practical remark, as this could cause considerable waste of time and money.

It may be of interest that everything in connection with our last multi-million dollar refinery expansion program was awarded on a lump sum turnkey basis. Not only did this include the major units themselves, but it also included the outside battery limit piping systems, electrical distribution systems, cooling towers, tankage, pump houses, etc.

This policy required that our plans be fully developed before construction could proceed. Incidentally, this is the first time on a project of such magnitude and complexity, that our actual costs versus estimated costs were in close agreement. We feel that our policy with respect to complete design prior to construction was of major significance in this achievement.

On the whole, we found this article well worth reading.

LESTER M. GOLDSMITH
General Manager

Engr. & Const. Dept.
Atlantic Refining Co.
Philadelphia, Penna.

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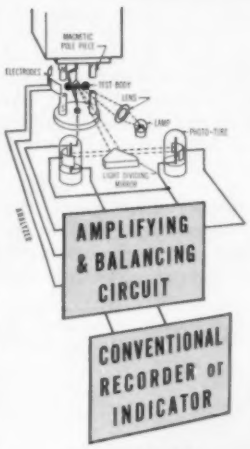

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 (To obtain more data on advertised products see page 1620)

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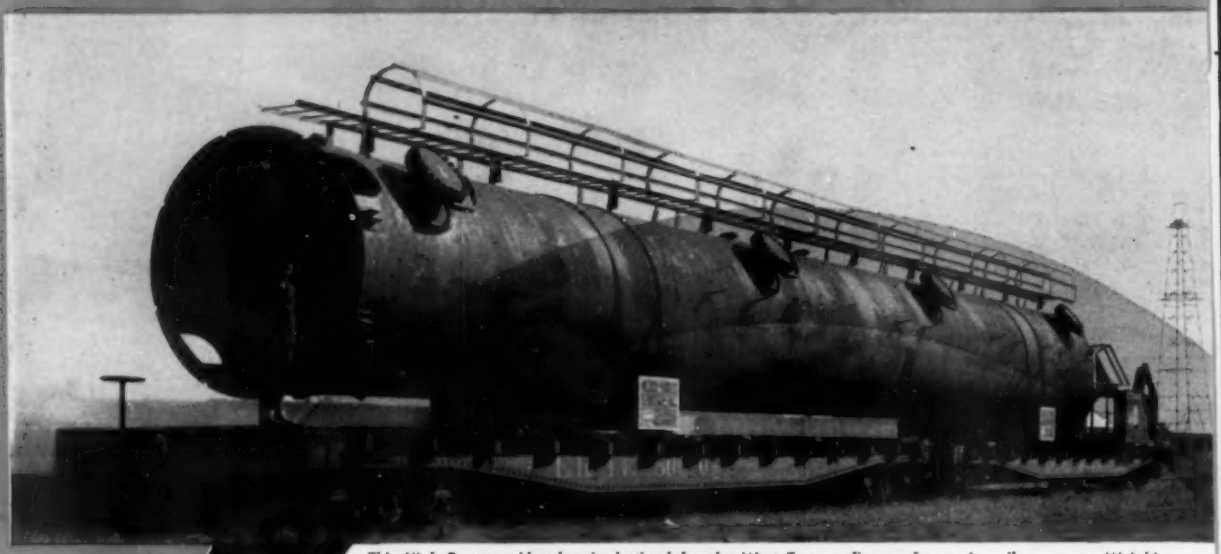

This High Pressure Absorber is destined for the West Texas refinery of a major oil company. Weighing more than 197,000 lbs., it has a shell plate thickness of 1.52", and is 7'-6" in diameter by 82'-3" long.

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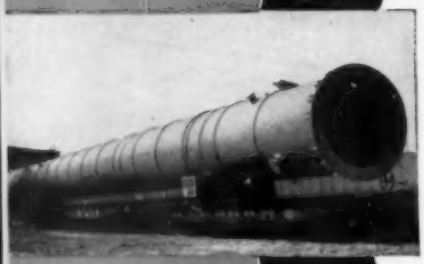

On its way from our Oklahoma City plant to an Illinois refinery via three railroad flat-cars, is this 4'-6" by 140' "Long John." Its total weight is only 54,000 lbs.

Bound for a Gulf Coast refinery is this 124,000 lb. pressure vessel, fabricated by BS&B. With over-all dimensions of 13' by 137', three flat-cars are required to transport it.

The technology of petroleum processing and refining has come a long way since we built our first pressure vessel for the industry some 25 years ago. But with development of newer and more advanced processes and techniques has come the challenging demand for specially fabricated pressure vessels of complicated design to meet the exacting requirements of the new processes.

BS&B, with some of the largest and most modern custom fabrication facilities west of the Mississippi River, has become known as one of the industry's leading quality fabricators of custom equipment.

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EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

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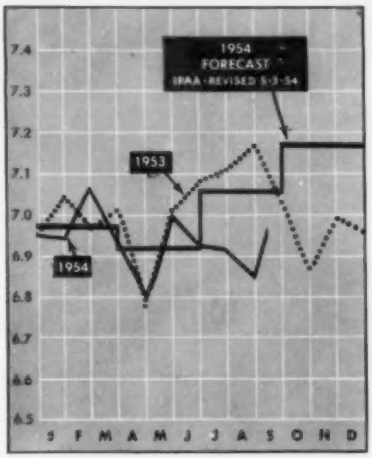
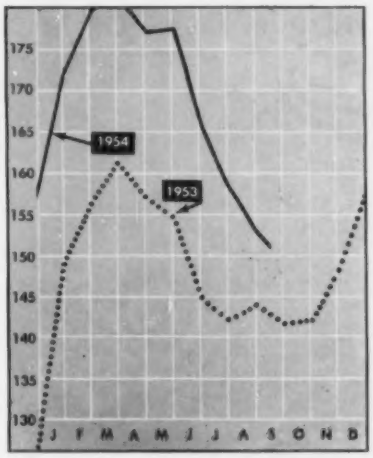
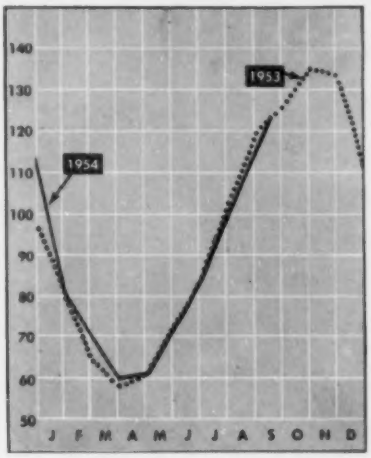
2131 Westwood Blvd. P. O. Box 1714 Oklahoma City, Oklahoma



CRUDE RUNS TO STILLS
(Millions of b/d, monthly averages)



PRIMARY GASOLINE STOCKS
(Millions of bbls., end of month)



PRIMARY DISTILLATE STOCKS
(Millions of bbls., end of month)

Gasoline Stocks Too High for Oct. 1

OUTLOOK: Crude runs will likely top 7,100,000 b/d during the fourth quarter — Gasoline inventories at refineries may reach 163,000,000 bbls. by Dec. 31—Retailers will hold off coming into the heating oil market unless cold weather hits early.

General: Refiners reached the start of the fourth quarter with gasoline stocks about 12,000,000 bbls. higher than required for market stability. Heating oil inventories (kerosine and distillate) for the U.S. are adequate in total volume, though a little lower than a year ago.

Total U.S. primary stocks of the four large volume products on Sept. 10 were the highest on record, 368,455,000 bbls., about 13,600,000 bbls. higher than Sept. 11, 1953. This volume may be increased if the early winter is mild and refiners' inventories of distillate and kerosine are not heavily drawn on and if gasoline stocks continue to build up.

Crude Runs: Charges to stills started to increase in September, after averaging approximately 6,900,000 b/d for the third quarter. This was approximately 200,000 b/d avg. lower than actual runs for the third quarter of 1953. Indications are fourth quarter runs will be higher. Forecast runs are 7,160,000 b/d avg.

Gasoline: Refiners' inventories for the U.S. Sept. 10 were about 11,800,000 bbls. (8.3%) larger than Sept. 11, 1953. East of California stocks of 134,964,000 bbls. were 13,990,000 bbls. (11.6%) larger. The largest surplus continues to be in the Ind.-Ill.-Ky. district, where its 34,960,000 bbls. is 21.2% higher than last year.

Heating Oils: The lower rate of operations in the Gulf Coast district has resulted in stocks of kerosine and distillate in the combined East and Gulf Coast areas being 6.3% lower on Sept. 10 than Sept. 11, 1953. However, inventories are considered adequate unless early winter is abnormally severe. Stocks in the inland districts are larger than last year. Stocks of 34,535,000 bbls. Sept. 10 in Ind.-Ill.-Ky. were 8.8% higher.

Residual Fuels: East of California stocks of 28,613,000 bbls. Sept. 10 were 10.6% less than a year ago. The overage of 8,347,000 bbls. in California brought the total for the U.S. to 56,725,000 bbls., 9.6% higher than on Sept. 11, 1953.

KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbls. at end of month)

CRUDE OIL	Sept. 1954*	Aug. 1954	Sept. 1953
U. S. Production	6.174	6.137	6.557
Imports	.671	.681	.692
U. S. Stocks	272.695	275.780	289.614
Runs to Stills	6.973	6.859	7.023
GASOLINE			
Refinery Output	3.412	3.388	3.432
Refinery Demand	3.629	3.640	3.580
Primary Stocks	151.787	153.608	141.902
HEATING OILS			
Refinery Output	1.783	1.740	1.746
Refinery Demand	1.173	1.139	1.469
Primary Stocks	161.665	151.288	163.137
RESIDUALS			
Refinery Output	1.098	1.092	1.203
Imports	.270	.248	.295
Total Supply	1.368	1.340	1.498
Refinery Demand	1.297	1.297	1.498
Primary Stocks	57.268	56.067	50.516

*Through Sept. 17, except Crude Stocks, which are B. of M. data one day later.

PRODUCT AND CRUDE PRICES

Products—¢ gal., weighted average prices in principal refinery markets
Crudes—$/bbl., principal fields
Source—Platt's Oilgram Price Service

	Sept. 1954*	Aug. 1954	Sept. 1953
Gasoline	11.46	11.44	12.46
Distillates	10.25	8.73	8.99
Kerosine	8.74	10.24	10.32
Residuals	3.87	3.83	3.93
Above 4 Products	8.71	8.69	9.28
Lube Oils	16.30	16.30	18.77
Crude	2.81	2.81	2.84

REFINERY YIELDS

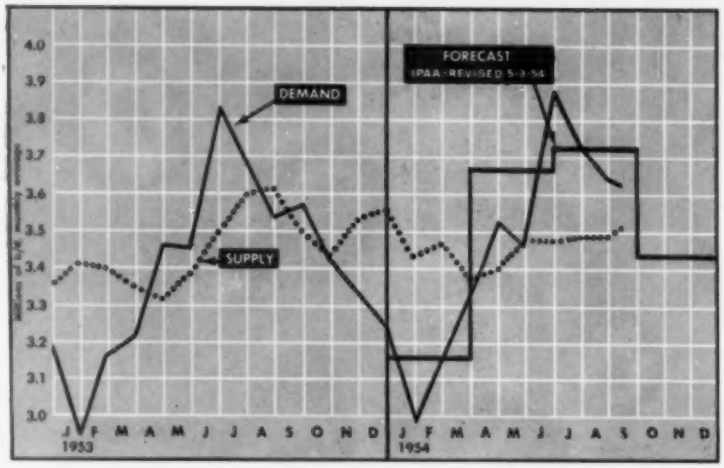
% on Crude Runs to Stills

	Sept. 1954*	Aug. 1954	Sept. 1953
Gasoline	48.9	44.7	43.9
Kerosine	5.0	4.4	4.4
Distillates	20.6	21.0	20.3
Residuals	15.7	15.9	17.0

*Through Sept. 17

SOURCE OF DATA (except prices): July, Aug. and Sept., API weekly reports; earlier months, Bureau of Mines

Gasoline Demand Levels Off in September

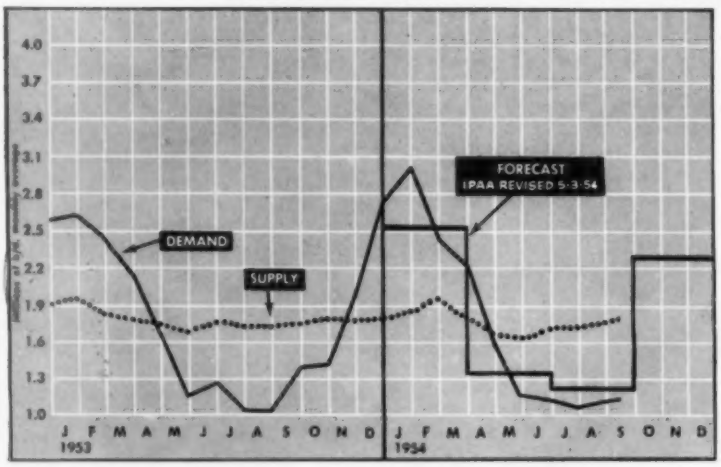


MOTOR FUEL

	From Crude	From Nat. Gas	Total
SUPPLY (Millions of b/d)			
Sept. '54*	3.085	.437	3.522
Sept. '53	3.099	.402	3.501
Change	—.014	+.035	+.021
% Change	—0.5	+8.7	+0.6
DEMAND (including Exports) (Millions of b/d)			
Sept. '54*			3.629
Sept. '53			3.580
Change			+.049
% Change			+1.4
TOTAL SUPPLY (Millions of bbls.)			
8 Mos. '54	738.918	100.516	839.434
8 Mos. '53	745.613	93.435	839.048
Change	—6.695	+7.081	+.386
% Change	—0.9	+7.6	0.
TOTAL DEMAND (including Exports) (Millions of bbls.)			
8 Mos. '54			844.009
8 Mos. '53			829.915
Change			+14.094
% Change			+1.7

*Through Sept. 17 only; may not be indicative of trend for entire month.

Moderate Upward Turn in Heating Oil Demand

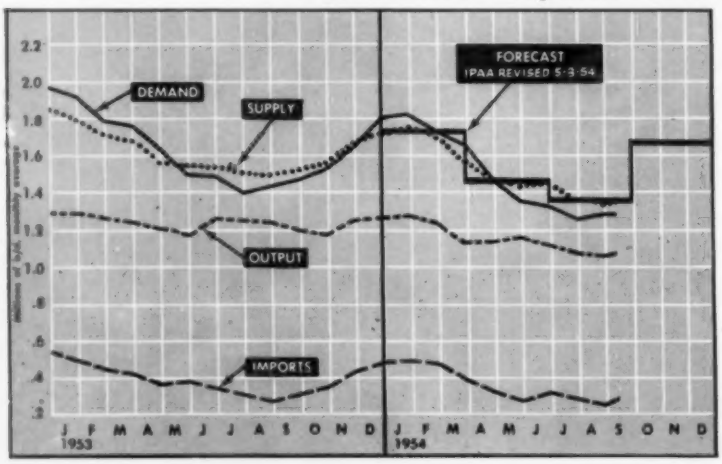


HEATING OILS

	Kerosine	Dist. Fuels	Total
PRODUCTION (Millions of b/d)			
Sept. '54*	.346	1.437	1.783
Sept. '53	.310	1.436	1.746
Change	+.036	+.001	+.037
% Change	+11.4	0.	+2.1
DEMAND (including Exports) (Millions of b/d)			
Sept. '54*	.184	.989	1.173
Sept. '53	.255	1.214	1.469
Change	—.071	—.225	—.296
% Change	—27.8	—18.6	—20.2
TOTAL PRODUCTION (Millions of bbls.)			
8 Mos. '54	81.580	347.968	429.548
8 Mos. '53	82.160	351.971	434.131
Change	—.580	—4.003	—4.583
% Change	—0.7	—1.1	—1.1
TOTAL DEMAND (including Exports) (Millions of bbls.)			
8 Mos. '54	74.857	345.795	420.652
8 Mos. '53	74.246	335.687	409.933
Change	+.611	+10.108	+10.719
% Change	+0.8	+3.0	+2.6

*Through Sept. 17 only; may not be indicative of the trend for the entire month.

Residual Fuel Shipments Continue Light



RESIDUAL FUELS

	Refinery Output	Imports	Total
SUPPLY (Millions of b/d)			
Sept. '54*	1.098	.270	1.368
Sept. '53	1.203	.295	1.498
Change	—.105	—.025	—.130
% Change	—8.7	—8.5	—8.6
DEMAND (including Exports) (Millions of bbls.)			
Sept. '54*			1.297
Sept. '53			1.498
Change			—.201
% Change			—13.5
TOTAL PRODUCTION (Millions of bbls.)			
8 Mos. '54	282.069	85.070	367.139
8 Mos. '53	301.829	88.986	390.815
Change	—19.760	—3.916	—23.676
% Change	—6.5	—4.4	—6.1
TOTAL DEMAND (including Exports) (Millions of bbls.)			
8 Mos. '54			363.592
8 Mos. '53			393.368
Change			—29.776
% Change			—7.6

*Through Sept. 17 only; may not be indicative of the trend for the entire month.

SOURCE OF DATA: July, Aug. and Sept., API weekly reports; earlier months, Bureau of Mines

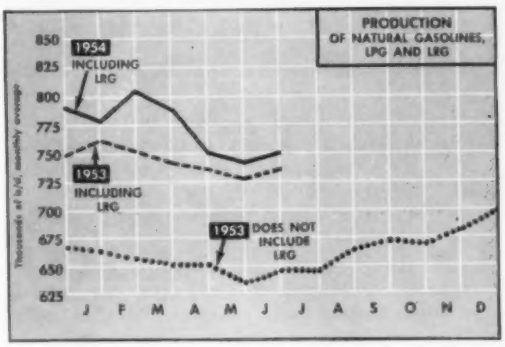
RUNS TO STILLS and DISTRIBUTION OF PRIMARY STOCKS BY U.S. REFINERY DISTRICTS

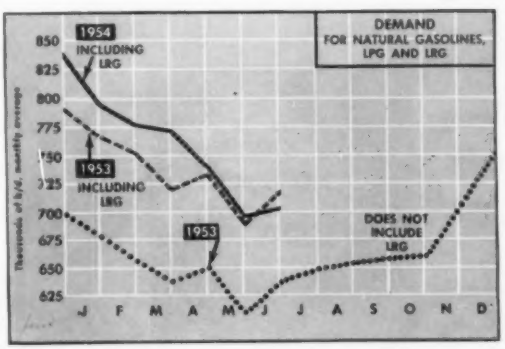
(Primary stocks include those at refineries, at large ter minals and in pipelines; all data based on API reports)

District	RUNS TO STILLS (Millions of b/d average for week ending on date shown) Sept. 10 1954	Sept. 11 1953	Change	% Change	GASOLINE STOCKS (Millions of bbls., on date shown) Sept. 10 1954	Sept. 11 1953	Change	% Change	RESIDUAL STOCKS (Millions of bbls., on date shown) Sept. 10 1954	Sept.11 1953	Change	% Change
East Coast	1.017	1.065	—.048	—4.5	33.766	33.652	+ .114	+ 0.3	11.562	14.011	—2.449	—17.5
Gulf Coast	2.305	2.296	+.009	+0.4	29.206	25.271	+ 3.935	+15.6	8.072	8.444	— .372	— 4.4
Total Coastal	3.322	3.361	—.039	—1.2	62.972	58.923	+ 4.049	+ 6.9	19.634	22.455	—2.821	—12.6
Appalachian	.177	.195	—.018	—9.7	6.320	4.947	+ 1.373	+27.8	.813	.860	— .047	— 5.4
Ind.-Ill.-Ky.	1.256	1.316	—.060	—4.6	34.946	28.832	+ 6.114	+21.2	4.757	4.784	— .027	— 0.6
Okla.-Kans.-Mo.	.611	.614	—.003	—0.5	14.819	14.893	— .074	— 0.5	1.151	1.190	— .039	— 3.3
Other Inland	.598	.636	—.038	—6.0	15.907	13.379	+ 2.528	+18.9	2.258	2.706	— .448	—16.6
Total Inland	2.642	2.761	—.119	—4.3	71.992	62.051	+ 9.941	+16.0	8.979	9.540	— .561	— 5.9
Total East of Calif.	5.964	6.122	—.158	—2.6	134.964	120.974	+13.990	+11.6	28.613	31.995	—3.382	—10.6
California	1.025	1.094	—.069	—6.3	18.315	20.514	— 2.199	—10.7	28.112	19.765	+8.347	+42.2
Total U.S.	6.989	7.216	—.227	—3.1	153.279	141.488	+11.791	+ 8.3	56.725	51.760	+4.965	+ 9.6

District	DISTILLATE STOCKS (Millions of bbls., on date shown) Sept. 10 1954	Sept. 11 1953	Change	% Change	KEROSINE STOCKS (Millions of bbls., on date shown) Sept. 10 1954	Sept. 11 1953	Change	% Change	TOTAL HEATING OIL STOCKS (Millions of bbls., on date shown) Sept. 10 1954	Sept.11 1953	Change	% Change
East Coast	43.082	44.715	—1.633	— 3.7	14.331	14.790	—.459	— 3.1	57.413	59.505	—2.092	— 3.5
Gulf Coast	18.752	22.902	—4.150	—18.1	7.201	6.518	+.683	+10.5	25.953	29.420	—3.467	—11.8
Total Coastal	61.834	67.617	—5.783	— 8.6	21.532	21.308	+.224	+ 1.1	83.366	88.925	—5.559	— 6.3
Appalachian	2.732	2.073	+ .659	+31.8	1.119	1.158	—.039	— 3.4	3.851	3.231	+ .620	+19.2
Ind.-Ill.-Ky.	24.913	22.480	+2.433	+10.8	9.622	9.261	+.361	+ 3.9	34.535	31.741	+2.794	+ 8.8
Okla.-Kans.-Mo.	13.128	13.156	— .028	— 0.2	2.319	2.610	—.291	—11.1	15.447	15.766	— .319	— 2.0
Other Inland	6.144	5.675	+ .469	+ 8.3	1.768	1.537	+.231	+15.0	7.912	7.212	+ .700	+ 9.7
Total Inland	46.917	43.384	+3.533	+ 8.1	14.828	14.566	+.262	+ 1.8	61.745	57.950	+3.795	+ 6.5
Total East of Calif	108.751	111.001	—2.250	— 2.0	36.360	35.874	+.486	+ 1.4	145.111	146.875	—1.764	— 1.2
California	12.983	14.329	—1.346	— 9.4	.357	.375	—.018	— 4.8	13.340	14.704	—1.364	— 9.3
Total U.S.	121.734	125.330	—3.596	— 2.9	36.717	36.249	+.468	+ 1.3	158.451	161.579	—3.128	— 1.9

Natural Gas and Refinery Gas Liquids





SUPPLY AND DEMAND STATISTICS

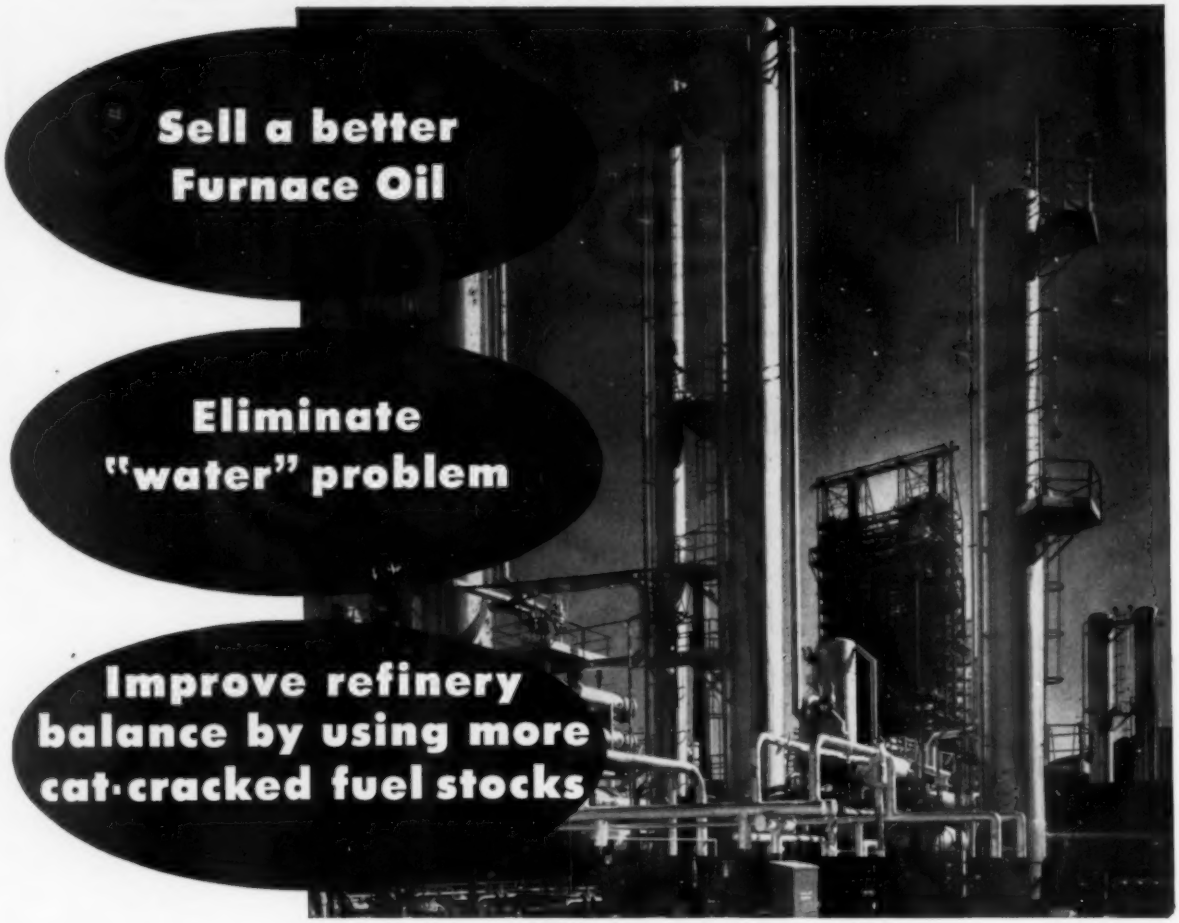
(Bureau of Mines Data)

CURRENT PRODUCTION (1000 b/d monthly average)	June 1954	May 1954	June 1953
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	299	304	284
Natural Gasoline and Isopentane	274	268	270
Condensate	27	28	26
Finished Gasoline, Naphtha and Others	59	57	68
Total Natural Gasoline and Cycling Plant Production	659	657	648
Liquefied Refinery Gases	94	90	88
Total Marketable Gas Liquids	753	747	736
Lease Condensate	99	101	86
Total Natural Gas Liquids	852	848	822
CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	354	345	353
Natural Gasoline, Isopentane and Others	349	350	365
Total Current Demand	703	695	718

CUMULATIVE PRODUCTION (1000 bbls.)	June 1954	June 1953
LPG and LRG	76,231	71,885
Natural Gasoline, Isopentane and Others	63,147	62,822
Total Marketable Gas Liquids	139,378	134,707
CUMULATIVE DEMAND (1000 bbls.)		
LPG and LRG	72,091	69,651
Natural Gasoline, Isopentane and Others	63,078	62,371
Total Cumulative Demand	135,169	132,022

STOCKS (1000 bbls., end of month)	June 1954	May 1954	June 1953
LPG and LRG	8,616	7,460	3,892
Natural Gasoline, Isopentane and Others	4,958	4,626	4,970
Total Stocks	13,574	12,086	8,862

With NEW Dispersant FO



Dispersant FO is a new gum-dispersing, rust-inhibiting additive that greatly reduces, even eliminates, deposits and screen clogging in home heating units and storage tanks. Your product with FO will offer dealers many competitive advantages and greatly reduce their number of costly service calls due to clogged filter screens and nozzles.

"Wet fuel" is always *the big problem* for the distributor, dealer and home user. The active ingredient in FO is an entirely new chemical, developed especially for use in furnace oils. NEW DISPERSANT FO DOES NOT EMULSIFY WATER WITH BURNER OIL. It will settle the water out of burner oils in short order to provide a "dry" fuel.

Furnace oil with FO has exceptional rust-proofing properties. Steel and iron surfaces in contact with the oil and the water layer are made corrosion resistant.

This new additive improves stability and permits the blending of higher percentages of cat-cracked stocks without additional gum formation. It improves refinery balance, and you can cut costs by reducing the severity of acid treating of your cat-cracked heating stocks.

The stabilizing action and rust-inhibiting quality of Dispersant FO are obtained at very low dosages. Usually added in the ratio of 1 pint per 1000 gallons of oil stock, at any temperature, prior to shipment by tanker, pipe line or truck.

For complete product data and samples, write or phone the nearest Oronite office.

ORONITE CHEMICAL COMPANY

200 Bush St., San Francisco 20, Calif. • 714 W. Olympic Blvd., Los Angeles 15, Calif.
30 Rockefeller Plaza, New York 20, N.Y. • 20 North Wacker Drive, Chicago 6, Ill.
Mercantile Securities Building, Dallas 1, Texas

ORONITE CHEMICAL COMPANY

2637

 (To obtain more data on advertised products see page 1620)

PETROLEUM CHEMICALS DIVISION

NEWS

October ★ One of a Series of Interest to the Petroleum Industry ★ 1954

No Country Like Our Country!

Each year, during Oil Progress Week, Americans can proudly celebrate the fact that in no other country are the people so well supplied with products and services that can only be made available through a great, progressive and competitive oil industry.

3 New Additives Recently Developed by Du Pont

Progress in the development of new petroleum additives has been rapid at Du Pont during the past year and a half.

The most recent of these is Lube Oil Additive 564. Now, for the first time in the history of motor oil additives, Lube Oil Additive 564 provides a viscosity index improver with effective detergent-dispersant action to overcome sludge problems caused by continuous low-duty stop-and-go engine operation. Its detergent action is also effective under medium and heavy-duty conditions. And Lube Oil Additive 564 is ashless, a unique quality in a detergent.

What's more, this new additive is highly effective in low concentrations and can, therefore, be used at reasonable cost. It is expected that it will prove especially valuable in motor oils used in urban car and delivery truck fleets, as well as in the average driver's car.

Another effective new additive recently announced by Du Pont is Estersil GT—a water-repellent silica grease thickener. This additive makes possible multi-purpose greases with unusually high shear and thermal stability.

Du Pont Fuel Oil Additive No. 2, announced only a little more than a year ago, has already proved its worth as a stabilizer and dispersant for both heating and diesel oils.

SERVICE!...

It has become a symbol of the Petroleum Industry . . . and it is the key policy of the Du Pont Petroleum Chemicals Division

In the language of the American motorist, "petroleum products" and "service" have become almost synonymous.

When the motorist needs gasoline, he looks for a *service* station. When he buys motor oil or chassis lubrication, he refers to his purchase as having his car "serviced." During the past half century, the tremendous growth of the petroleum industry has been built on *service* . . . and the public has benefited richly from it.

A UNIQUE SERVICE for refiners and marketers is the quarterly Du Pont Motor Gasoline Survey. It is based on hundreds of service station samples collected by Du Pont representatives every three months.

At Du Pont, we have designed our services in connection with additives to be outstanding, too . . . and many of these are the kind that stimulate your business at the service station and consumer levels.

Marketing Services

Du Pont Petroleum Chemicals Division services cover a wide range of oil company activities. In marketing, for example, the Du Pont services are designed to fit in with the individual company's own sales promotion programs . . . to help them get *extra* mileage out of their promotion investment.

The recent extensive survey of consumer gasoline buying habits is one example of a Du Pont service that can be equally valuable to every oil company. And the Du Pont brand name, lube oil, and chassis dynamometer presentations can be easily tailored to meet individual marketing requirements. In addition, Du Pont also supplies marketers with a wide variety of dealer-training aids.

Technical Services

As oil technology progresses, new technical problems have a way of constantly cropping up. Since the solution to technical problems generally comes easier and faster when extra information is available, Du Pont makes available a number of widely varied technical services to assist refiners.

For example, our five well-equipped regional laboratories, conveniently located near the major refining areas of the country, work exclusively on oil and automotive industry problems. And the Du Pont fleet of fuel test cars is often called in to help refiners solve

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

CONTINUED "Service"

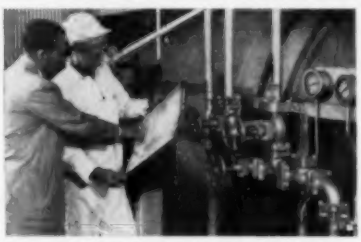
road performance problems. Another unique Du Pont service is the engineering of tetraethyl lead blending plant design and construction.

In addition, the Du Pont Company continuously carries on basic research of value to the petroleum industry . . . and publishes many of the results in technical papers for the benefit of the whole industry. Also, Du Pont technical representatives are always available for consultation on manufacturing problems.

Safety, too!

In spite of the many occupational hazards which refiners must face daily, the industry has established an admirably high safety record throughout the years.

To help you maintain this fine record, the Du Pont safety and medical



DU PONT REPRESENTATIVES work closely with refinery blending plant personnel on tetraethyl lead handling problems.

services include stand-by personnel for tank-cleaning operations. Also a variety of interesting talks as well as worker examinations by doctors specializing in tetraethyl lead hazards. In addition, aid is given in the design of special safe-handling apparatus for blending plants and, finally, a broad range of personnel-training aids is also available.

In Addition . . .

Du Pont offers many services of a general nature. The Quarterly Gasoline Quality Survey is one example. And to aid the industry in its over-all public relations activities, Du Pont has contributed the famous "Magic Barrel" show and a number of educational films such as, "Pipeline on Wheels," "It Never Rains Oil," and What Makes A Gasoline Good."

Are *you* taking full advantage of these helpful services? If not, you can easily request them through any of our regional offices listed below.

Still Rolling! . . .

"MAGIC BARREL" SHOW TELLS UNIQUE PUBLIC RELATIONS STORY TO MANY MILLIONS

Our modern petrochemical industry makes "Aladdin's Lamp" look like a piker.

And *millions* of Americans are becoming increasingly aware of this through seeing the Du Pont-designed "Magic Barrel," which is currently being presented by individual oil companies and the OIIC.

During the past year, the "Magic Barrel" has starred on more than 50 different television programs, playing to many million people. Approximately 300,000 have seen the show through lecture presentations to civic groups, service clubs, luncheon meetings, employee and customer gatherings.

Your future customers are learning more about the oil industry from it, too. By the end of this year, it is planned that the "Magic Barrel" will have been seen by every child in the City of New York school system. And it is also being shown to thousands of other school children and college students across the country.

To get the project rolling initially, Du Pont designed and supplied the original barrels, and furnished many of the oil-based products in the show. There are now 148 "Magic Barrels" on the road. Du Pont also helped in the training of the more than 600 oil industry employees who present the show.

Now—it's the "MAGIC SUITCASE"

The women, it seems, are not to be outdone when it comes to using ingenious products made from petrochemicals.

CONNIE MOON, originator of the "Magic Suitcase" and women s program director for the OIIC, is shown here demonstrating a dramatic dye-bath with oil-based fabrics and dyes.

The OIIC has come up with a new demonstration-lecture which combines entertainment with the story of oil in a woman's world. Called the "Magic Suitcase," the demonstration is built around a small suitcase containing 35 oil-based products. They range from shimmering fabrics to sunglasses, perfumes and lipsticks.

The speaker, moreover, appears before her audience "dressed in oil"—in clothes made of "Orlon" acrylic fiber, "Dacron" polyester fiber, nylon, or some other new fiber created with oil and modern chemical science.

During Oil Progress Week and throughout the coming year, the "Magic Suitcase" will be shown to women's clubs, PTA meetings, church and other group gatherings.

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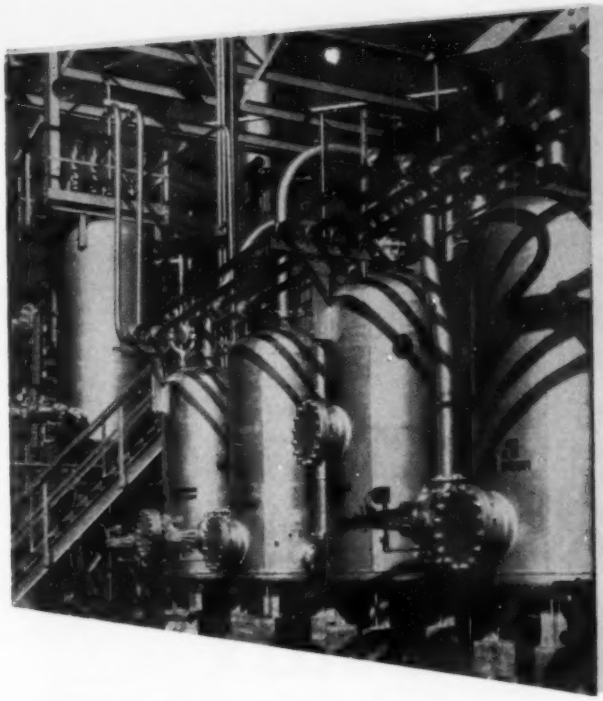

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QUALITY—The nation's finest refiners know they can *always* count on SOLVAY for purity that never varies . . . purity that meets the highest standards. And you get SOLVAY's high quality—*at no increase in price!*

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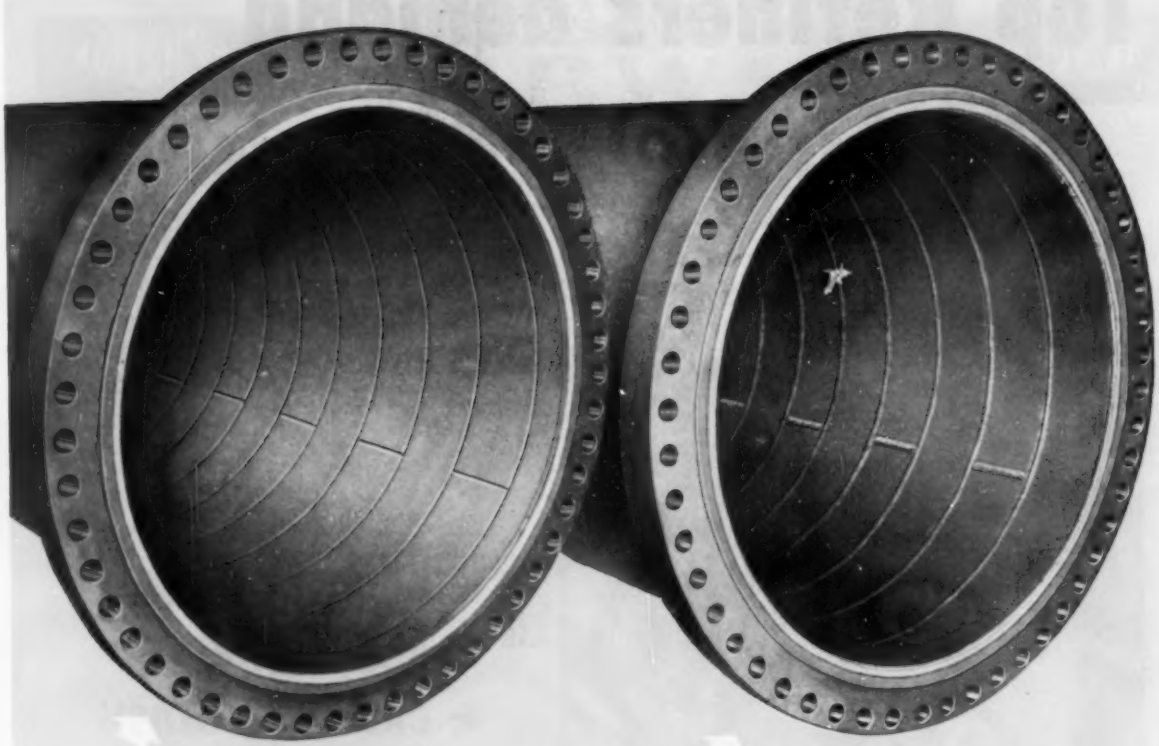

Lining Fitted—Before Welding *Vessel Completely Lined—After Welding*

For Special *Lined* Processing Vessels

Come to STRUTHERS WELLS

LINING processing vessels of all kinds for chemical plants and refineries is another service in which Struthers Wells specializes. Years of engineering experience and extensive fabricating facilities enable us to build lined vessels that meet all codes and requirements.

The vessel illustrated is Inconel-lined, 36″ I.D. x 43′ high. Working pressure is 600 lbs. Lining is welded to outer wall to become an integral part of the processing vessel.

Vessels can be furnished lined with titanium, stainless steel, nickel, silver, hastelloy and other weldable metals to suit your applications.

Struthers Wells

STRUTHERS WELLS CORPORATION

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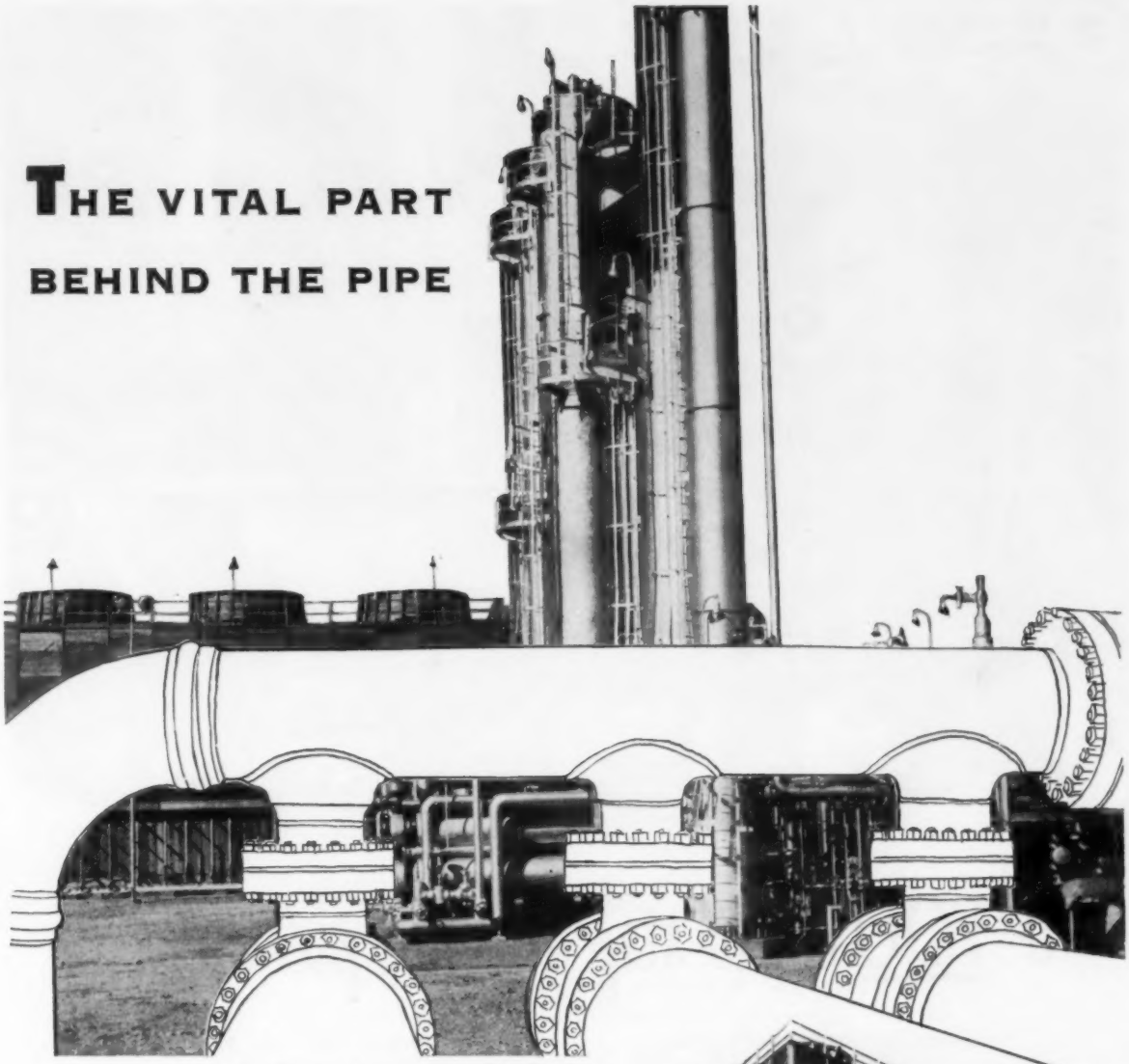
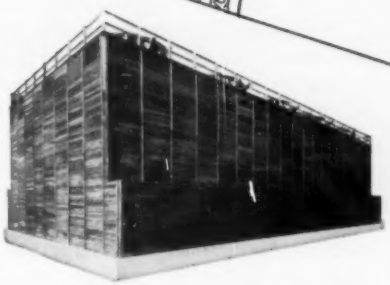
THE VITAL PART BEHIND THE PIPE



Look over the top of the pipe running across the picture. Right next to the fractionating columns, you'll see three fan throats of a multi-celled Pritchard cooling tower. Without the efficient functioning of that tower to cool process water, this modern refinery could not operate.

When you are choosing such a vital unit of your installation, remember that you can fully rely on Pritchard's proved design, engineering and construction abilities to provide the cooling tower that *best* meets your requirements.



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Representatives in Principal Cities from Coast to Coast

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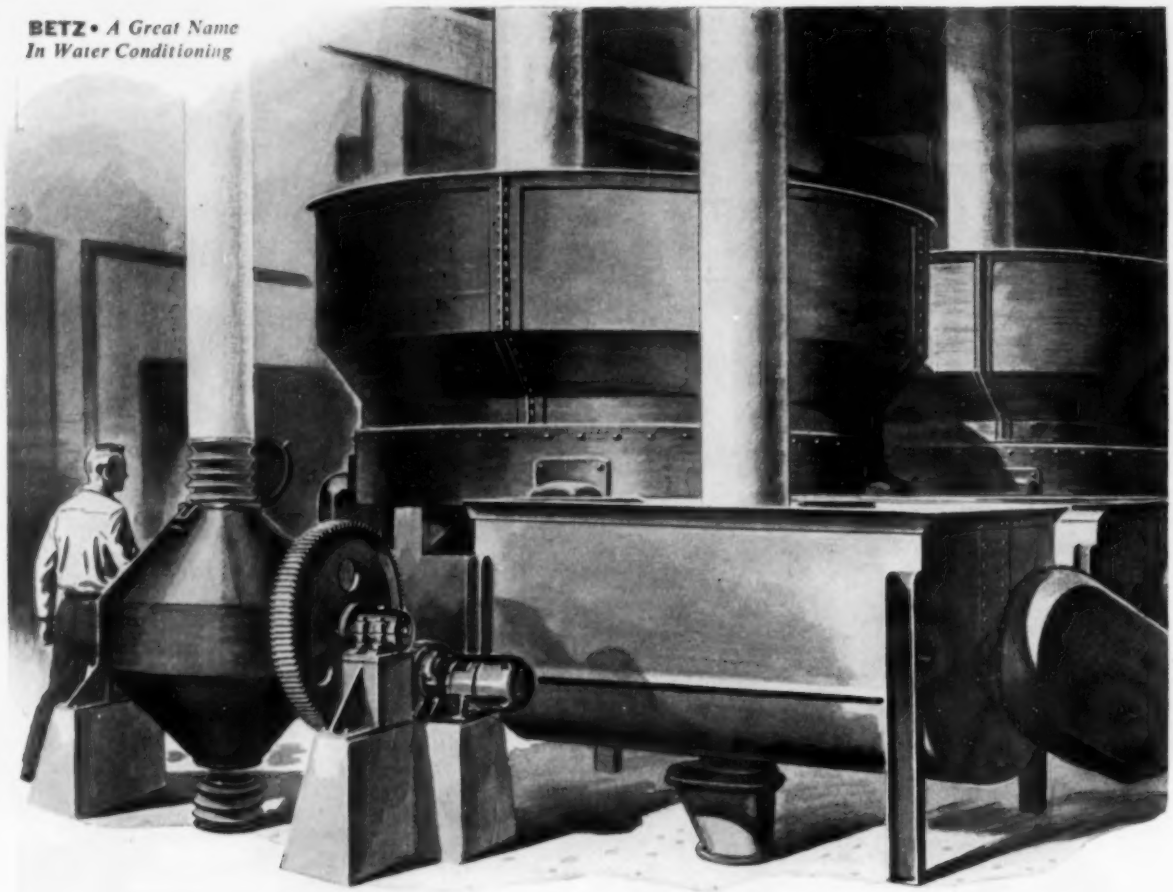

If YOU could step into this picture...

. . . you would find yourself in Philadelphia . . . or Texas . . . or California . . . or Montreal . . . in one of the four Betz strategically-located mixing and formulating plants.

Here you would see a battery of giant mixers, whose fingers of steel effortlessly blend and stir thousands of "prescriptions", each formulated to solve some *individual* water conditioning problem for industry. Perhaps you'd notice a special packaging machine, the extremely accurate weighing apparatus . . . or maybe a ton or two of chemicals neatly stacked, ready for formulating.

A little further along, you'd see row upon row of barrels, drums, and boxes ready for shipment . . . each bearing a different contents label.

Perhaps then you'd feel, as many other visitors have, that this division of the Betz Organization *actually performs the function of a giant pharmacy*—the focal point of Betz engineering skill and experience.

And you would profit by your visit, too, since you'd obtain an idea or two on how your plant could operate more efficiently and economically through the use of Betz *completely-integrated* water conditioning service.

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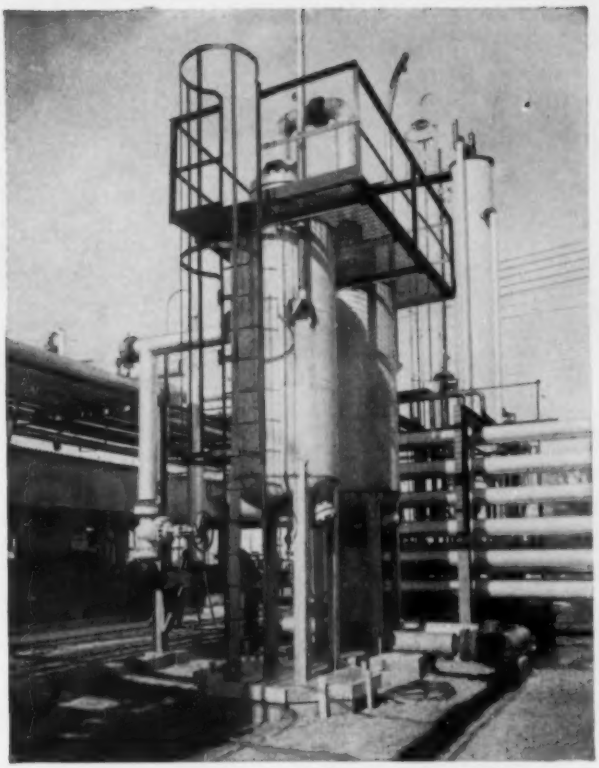
INTERESTED IN UNIFINING* FOR DESULFURIZATION AND UPGRADING



• First Commercial Unifining Unit
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UNIFINING should be of particular interest to all operators of catalytic reformers which produce by-product hydrogen.

• Harshaw is the exclusive producer of the Union Oil Company of California cobalt-molybdate catalyst used in the recently announced "Unifining" desulfurization and upgrading process. This rugged, commercially proven catalyst is supplied in the form of cylindrical tablets conforming to rigid physical and chemical specifications established by Harshaw and Union Oil Company of California. Stability at high temperatures permits repeated regenerations if and when necessary.

Please contact Harshaw for further information on this catalyst.

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 (To obtain more data on advertised products see page 1620)

Let Us "FIRE-ENGINEER" a system for your plant with AER-O-FOAM

The science of fire-engineering has come a long way since the era of the horse-drawn fire engine. Now you can protect your flammable liquid fire hazards by calling in National Foam engineers, who survey your plant and plan a modern fire-engineered system for your particular needs. They check locations, processes, flash points, existing system, water supply, and other factors. They recommend a basic AER-O-FOAM System with manual or automatic control, stationary or mobile operation, and all the proper equipment . . . foam chambers, overhead units, dip-tank systems, nozzles, extinguishers. After installation, National Foam furnishes a complete operating manual.

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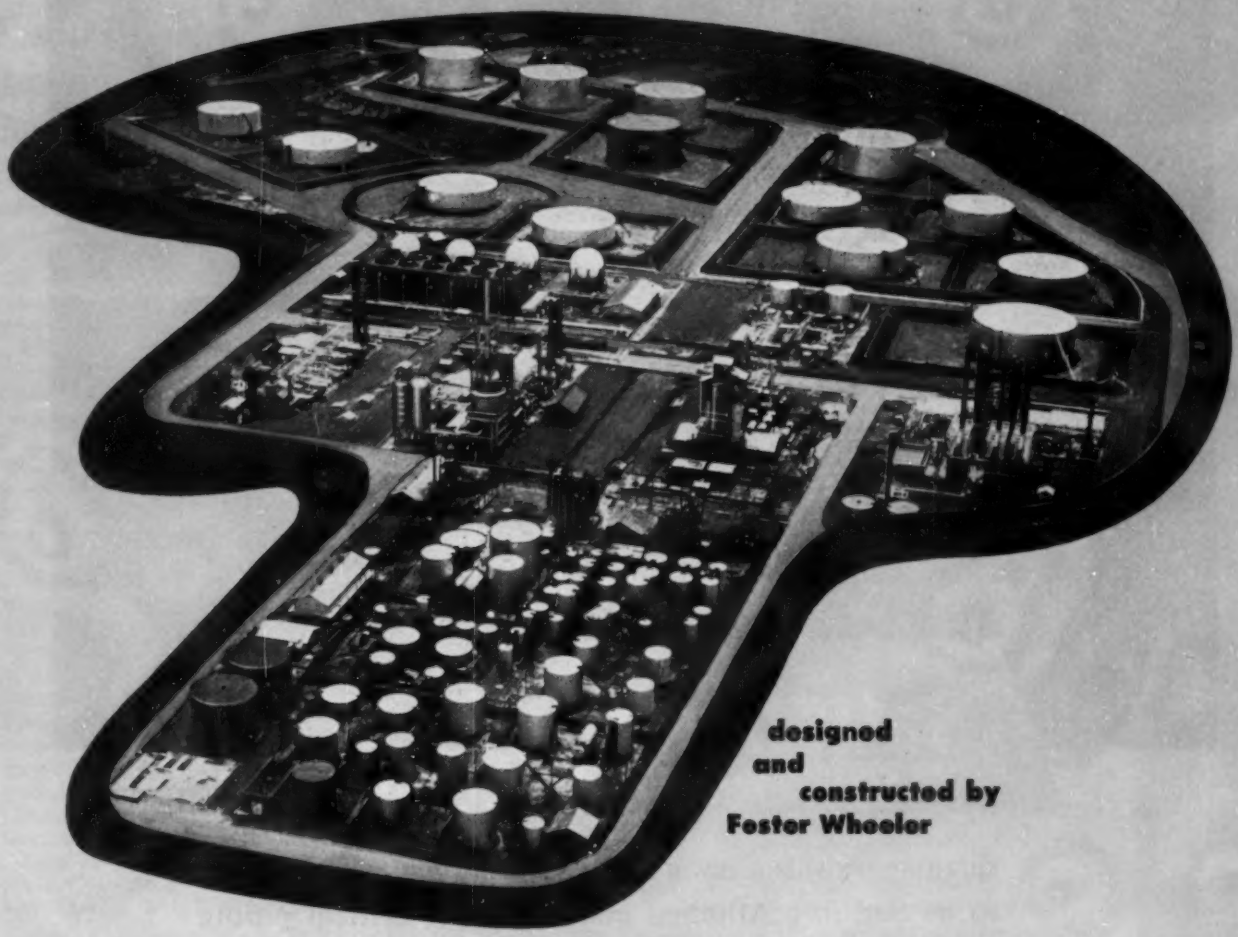
modernization at "Barrancabermeja"



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GOOD dogs and accurate shooting provide a reward no less keen than the satisfaction to be had in a Mitchell installation of critical piping. Save time and money on your next high-pressure or high-temperature job by enlisting the start-to-finish service of this 55-year-old organization of specialists.

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SINCE 1899

PIPING FABRICATORS AND CONTRACTORS

REFINERY PROCESS NEWS

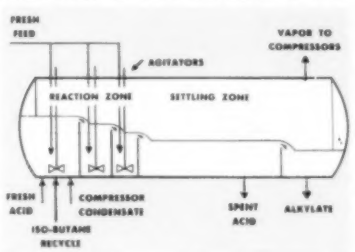
PUBLISHED BY REFINERY PROCESS DIVISION, THE M. W. KELLOGG COMPANY OCTOBER-NOVEMBER 1954

Special Kellogg Reactor Improves Quantity and Quality of Alkylate

Shown below is a simplified drawing of a typical Kellogg alkylation reactor, the principal feature of which is cascade flow of sulfuric acid catalyst and feed through a reaction zone consisting of three separate sections.

Briefly, in the Kellogg process, the isobutane-olefin feed is introduced into each of the three sections while isobutane recycle and fresh acid is introduced into the first section. During the reaction, which generally proceeds at a temperature between 38° and 40°F., the sulfuric acid drops in concentration due to dilution by moisture in the liquefied gas stream and side reactions with impurities in the feed. The acid is continuously withdrawn as it becomes spent, usually at a concentration of about 90%, though this may vary widely. Fresh acid is regularly introduced to keep the quantity and concentration in the reactor constant. The product of the reaction is passed through a caustic wash and then fractionated at higher temperatures.

One of the chief advantages of the Kellogg design stems from the fact that a 9-to-1 ratio of iso-



butane to butene is maintained in the reaction zones, although the actual ratio of isobutane to butene in the fresh feed plus recycle is only 4-to-1. Consequently, high quality alkylate is produced without adding to pumping and vessel costs in order to handle a large volume of isobutane which would otherwise be required to obtain this very desirable high concentration of the saturate in the reaction zones.

Another advantage is found in

(continued on following page)

The alkylation half of a new cat poly-alkylation combination unit recently completed by Kellogg as part of a major modernization program at a Midwest refinery. The combination unit provides maximum utilization of the light ends from a new Orthoflow cat cracker.

Combining Both Alkylation and Polymerization for Light Ends Processing Shows Many Advantages

The economical upgrading of surplus light refinery gases to more valuable products has been a continuing refinery problem and one which has consequently come in for considerable attention in Kellogg's research and development activities. Out of these efforts have come numerous contributions to the fields of alkylation and polymerization—both of which are now standard processes for converting light hydrocarbons to high-octane, low vapor pressure gasoline components.

Since the feedstocks required for these two processes are supplied by the refinery gas stream, they have usually been considered competitive to some degree. Each, of course, must be analyzed in the light of the particular situation in question and the results to be achieved. But while some circumstances would seem to call for alkylation and others for polymerization, economic studies — which have been supported by a number of recent refinery installations — have shown that in many instances the two processes are complementary rather than competitive. And in those cases where alkylation and polymerization have been combined, the advantages of the resulting processing scheme have far exceeded what could be expected from individual installations of either process.

Low Cat Poly Conversion Improves Alkylation Feed

For example, in a typical alkylation-polymerization operation, the combined C-3 and C-4 stream can be passed first through the poly unit under low conversion conditions (using a lower temperature and a higher space velocity than under normal conversion operations) so that a quantity of unsaturates remain unconverted. These unsaturates are sufficient to alky-

(continued on following page)

KELLOGG
FLUID CATALYTIC CRACKING
KELLOGG
FLUID HYDROFORMING
KELLOGG
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KELLOGG
VACUUM DISTILLATION
KELLOGG
DECARBONIZING DESULFURIZATION

(continued from previous page)

Advantages...

late all of the available refinery isobutane in the subsequent alkylation step. Moreover, the low conversion conditions selectively convert the propylene and isobutene (the latter an undesirable component for alkylation purposes) to polymer gasoline, and isomerize butene-1 to butene-2. The unreacted stream from the polymerization unit thus not only contains a good ratio of isobutane-butene, but the butene, being the "2" isomer, is most effective for alkylation feed.

Several advantages result from combining polymerization and alkylation in this manner. *First*, all refinery isobutane is converted to alkylate and upgraded in value to the maximum extent. *Second*, the refiner is able to further increase his gasoline production through vapor pressure blending with less volatile normal butane and *third*, less severe polymerization appreciably increases catalyst life, reducing operating costs.

(continued from previous page)

Special Reactor...

the cascade flow of acid and feed from the first section onward. Fresh acid, charged to the first section, flows through the other two sections before entering the hydrocarbon-acid settling portion of the reactor. Since the olefin-isobutane reaction is a very rapid one, it is completed in the reaction sections while the acid concentration is still relatively high. This also contributes to higher quality alkylate.

For further information, technical data, etc., on any refining process, write

REFINERY PROCESS DIVISION

THE M. W. KELLOGG COMPANY

225 Broadway, New York 7, N. Y.

In Canada
The Canadian Kellogg Company, Limited

In Europe
Kellogg International Corporation

KELLOGG PULLMAN

This is the new catalytic polymerization unit which is integrated with the alkylation unit pictured on the previous page and now operating at a Midwest refinery.

Kellogg Developments Reduce Cost of Catalytic Polymerization

As an original member of the Polyco Group, Kellogg has been intimately associated with the development of the cat poly process from its beginning.

In this process, polymerization of light, unsaturated hydrocarbons is accomplished in the presence of a catalyst under moderate temperature conditions (up to 500°F.) at pressures up to 2000 pounds. Under these conditions, the paraffin hydrocarbons in the stream are not converted to olefins. They consequently pass through the unit unchanged so that they are available for a subsequent alkylation step or for some other use. By the elimination of any cracking action in the process, the quality of the product can be closely controlled. Lower initial costs of installation and lower operating costs are also important factors in favor of catalytic polymerization.

Kellogg has contributed even further toward greatly reduced initial costs by building units, wherever possible, that utilize soaking drums from outmoded thermal cracking units. And in its continuing efforts to reduce daily operating costs, Kellogg has perfected a long-life catalyst that appreciably lengthens on-stream runs.

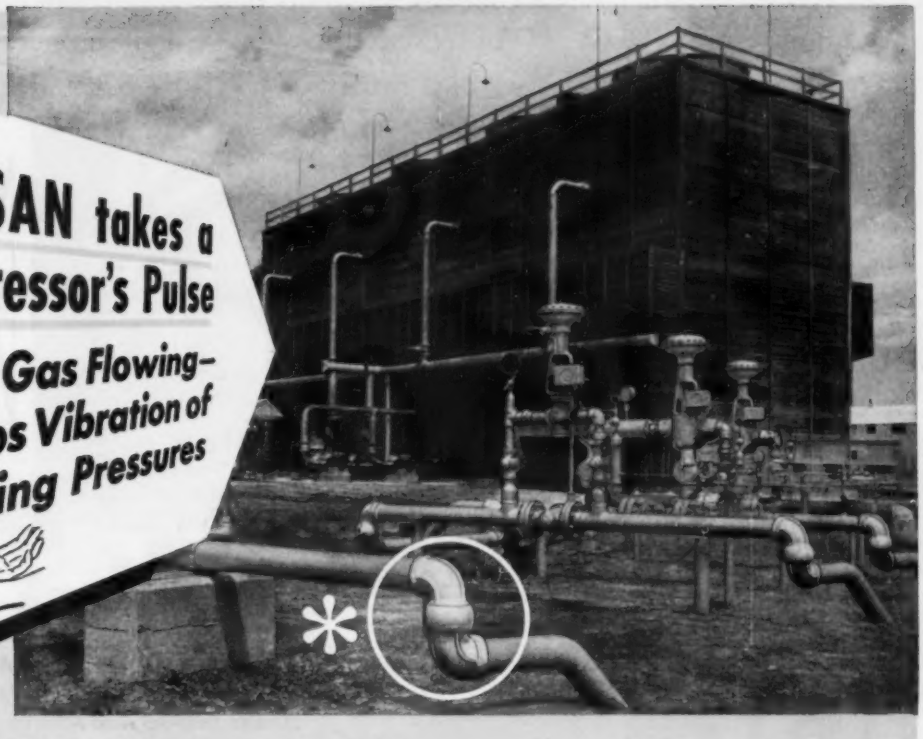
This catalyst, copper pyrophosphate, was developed in Kellogg's Jersey City, N. J. laboratories. Unlike other polymerization catalysts, which tend to agglomerate quickly under the pressures utilized in the process, the Kellogg catalyst retains its original pelleted form and resists softening to a high degree.

Process Adaptable for Other Products

In addition to polymerizing propylene and butylenes in the refinery gas stream to make high-octane blending gasolines, special feedstocks may be utilized in substantially the same equipment and with the same catalyst to produce other valuable products such as cumene from benzene and propylene.

CHIKSAN takes a Compressor's Pulse

Keeps Gas Flowing—Absorbs Vibration of Changing Pressures



Not only do the stamina and flexibility of Chiksan Joints take expansion in their stride, they absorb pulsation and vibration.

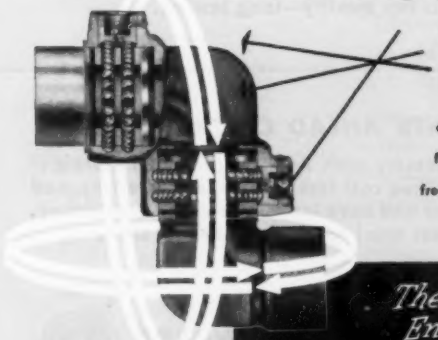
When the Plymouth Oil Company wanted a better way to handle the expansion and contraction of its 2500-3500 lb. natural gas re-pressuring line in its compressor station in Sinton, Texas, back in 1946, it tried Chiksan 2-inch high pressure ball bearing swivel joints. So successful were Chiksan Joints in this application, they were adopted for 3 and 4-inch lines for the same purpose. In addition, by placing regulators, gauges and other recording equipment on a bridge using Chiksan Joints, accurate readings of the instruments could be obtained.

Since 1946, not one of these Chiksan Joints has been replaced or even repacked, and they are giving the same economical, dependable service they did when first installed.

In Texas or California — all over America and all around the world — wherever production, processing or distribution depends on the flow of liquid or gas or on the dependability of hydraulic systems, there you will find Chiksan Ball Bearing Swivel Joints on the job — adding muscle and flexibility — cutting down on shut-downs and maintenance.

Whatever your business, if gas or liquid plays a part, Chiksan's Research and Development Division can help you add efficiency, safety and economy to your operation.

Representatives in Principal Cities
Write for Catalog 53-C, Dept. 10-PP



CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry — with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles and sizes have been developed for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 75° to a plus 500° F. with packing materials for each specific type of service.

CHIKSAN TRADE MARK REG.

The Flow of Enterprise Relies on **CHIKSAN** *Ball-Bearing Swivel Joints*

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 28, Illinois • Newark 2, New Jersey
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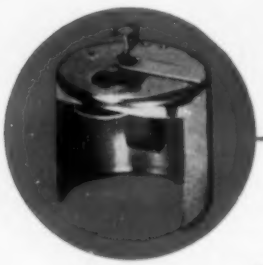
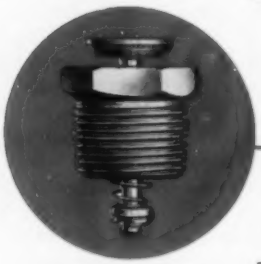
Here's a *Real*

STEAM TRAP PACKAGE



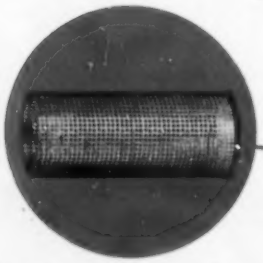
WANT FAST HEAT-UP OF OFF-AND-ON PIPE COILS, HEADERS, UNIT HEATERS, ETC.?

Speed heat-up with Armstrong thermic bucket traps. When steam is first turned on, air is pushed out the large thermic vent—fast! As soon as steam reaches the trap a thermic strip closes the vent, then the bucket functions as a regular bucket. Traps with thermic vent buckets discharge air 50 to 100 times faster than other traps.



NEED A CHECK VALVE AHEAD OF TRAP?

Just specify Armstrong with internal check valve. No check valve installation labor or fittings needed. Spring loaded action and vertical position minimize danger of dirt holding valve open. The Armstrong internal check valve is top quality—long lasting.



NEED A STRAINER AHEAD OF TRAP?

Save money with Armstrong built-in strainer traps. They cost less than a separate trap and strainer and save installation time and money. Stainless steel screen lasts a long time.

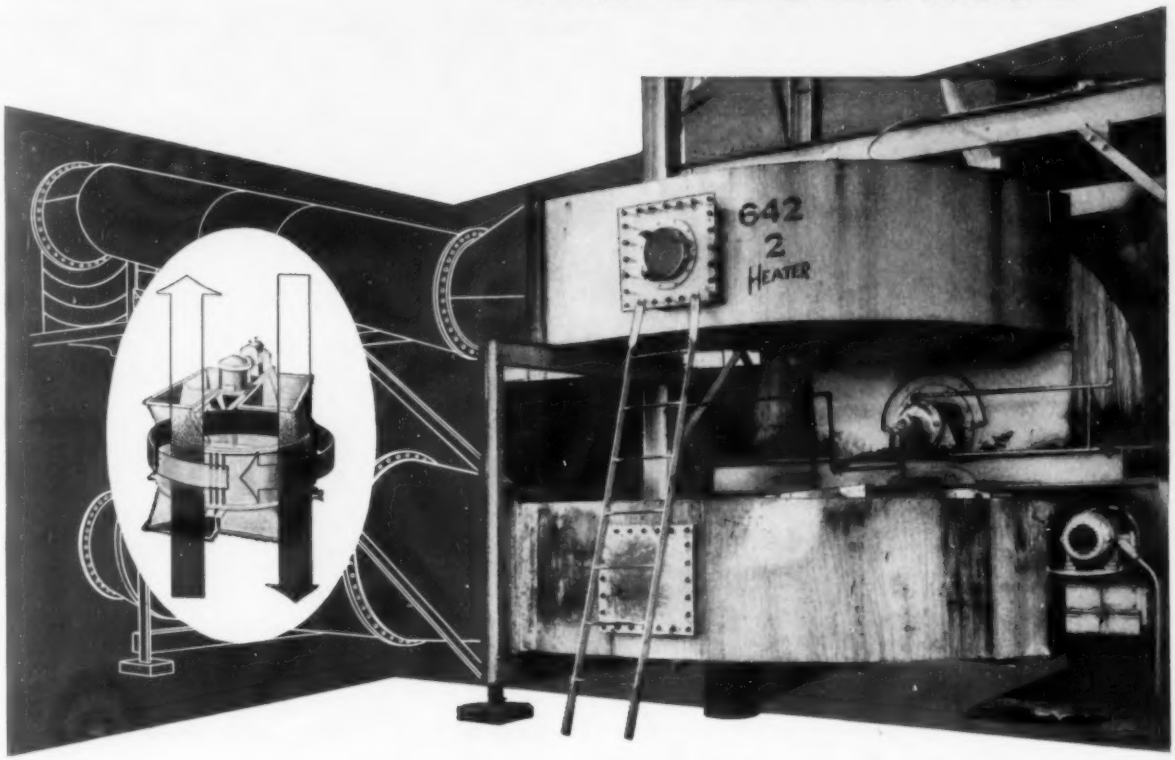
Get the full facts about all Armstrong traps. Send today for free Catalog J, The Armstrong Steam Trap Book.

ARMSTRONG MACHINE WORKS
826 Maple Street • Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

Replace Still Convection Surfaces . . .

. . . with a Ljungstrom Air Preheater



Wherever You Burn Fuel, You Need LJUNGSTROM

In purchasing new equipment — or modernizing existing equipment — one way to save impressive amounts of capital as well as operating expense is to design for a Ljungstrom Air Preheater.

Because the Ljungstrom promotes such greatly increased heat liberation in the furnace, the convection bank of oil tubes can generally be eliminated from the design. This can in itself *more than pay the cost of the Ljungstrom installation.*

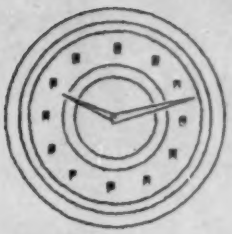
Add to this the proved fuel savings . . . the higher product quality . . . greater throughout possible with a Ljungstrom — and you will see why the Ljungstrom is an eminently practical piece of equipment to be considered wherever fuel is burned.

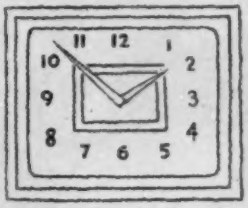
In these days of high fuel costs and skyrocketing demands for petroleum products, every refinery should consider a Ljungstrom whenever equipment is being purchased or modernized. Call or write The Air Preheater Corporation for complete details.

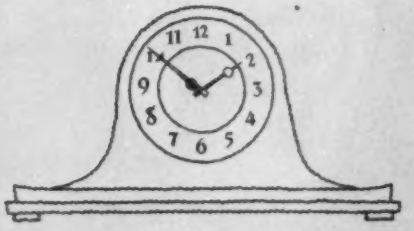
THE AIR PREHEATER CORPORATION
60 East 42nd Street, New York 17, N. Y.

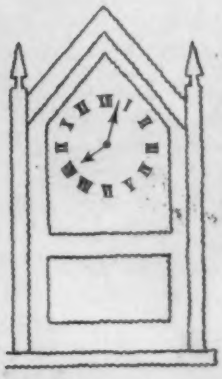
Down time means lost production for processors. "On stream" time means money in the bank. Wolverine products are designed to help you because . . .

Your Time is Important!





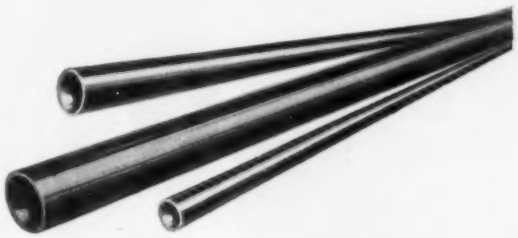




(To obtain more data on advertised products see page 1620)

On jobs where additional heat transfer in the same space is needed, Wolverine Trufin* Type S/T condenser tubing steps up the punch of shell and tube exchangers. Trufin's integral fins resist the shock of vibration and temperature change. That means a highly effective fin during operation. Too, Trufin can be substituted directly for prime surface tubes—can be rolled or brazed into headers by conventional methods.

Of course, in some applications, economics dictate the use of prime surface condenser tube. To save time for processors, Wolverine offers a one-source service: condenser tube in copper (and its alloys), aluminum, or electric-welded steel and in a wide variety of sizes. Trufin, incidentally, is available in these metals, too!



Another way to save time is to purchase a complete plain or finned U-Bend condenser tube installation and have it shipped in Wolverine's expendable box-type pallet. Wolverine uses your prints to arrange the U-Bends in the exact order of installation. All you have to do is feed them directly from pallet to condenser.

And then, too, when "sticklers" arise—questions concerning corrosion, alloys, heat transfer, other technical problems—Wolverine offers a complete Field Engineering Service. That's a good way to save engineering time.

Intriguing possibilities? Yes! You'll find more of the Wolverine time-saving story when you read the new books on condenser and heat exchanger tubes and the technical aspects of Trufin. Write for your copies—today! WOLVERINE TUBE, Division of Calumet & Hecla, Inc., 1441 Central Avenue, Detroit 9, Michigan.

*REGISTERED U. S. PATENT OFFICE

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario.

WOLVERINE TUBE

DIVISION OF CALUMET & HECLA, INC.

Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES

EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, N. Y.

Fluor

combines process experience with two proven methods to design and build better ammonia plants

Fluor is presently engaged in designing and building four ammonia plants representing a total investment of over $40,000,000. Each plant will use a different raw material: electrolytic and other by-product hydrogen, fuel oil, natural gas, and coke oven by-product gas. There is a wide range of source materials that may be used in ammonia plants designed and built by Fluor.

By special agreement with L'Air Liquide Societé of France, Fluor is using the Claude Process, long recognized as the world's outstanding method of ammonia synthesis. Fluor will draw upon the valuable experience of the Societé which, for 30 years, has developed high pressure techniques to a high degree of perfection while building and operating its own ammonia plants, in addition to building plants for others throughout the world.

Fluor is also licensed to employ the Texaco Partial-Oxidation Process, by far the most advanced means of manufacturing the hydrogen gas from which ammonia is synthesized.

This broad ammonia experience plus Fluor's recognized ability to design and construct processing facilities is your key to a better ammonia plant.

BE SURE WITH

FLUOR

THE FLUOR CORPORATION, LTD
LOS ANGELES 22, CALIFORNIA

FLUOR OF CANADA - TORONTO
FLUOR PERUANA, S.A. - LIMA
HEAD WRIGHTSON - LONDON

ENGINEERS
CONSTRUCTORS
MANUFACTURERS

NEW YORK
CHICAGO
PHILADELPHIA
BOSTON
PITTSBURGH
SAN FRANCISCO
HOUSTON
BIRMINGHAM
TULSA

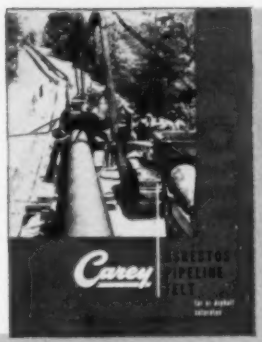
If YOUR JOB INVOLVES

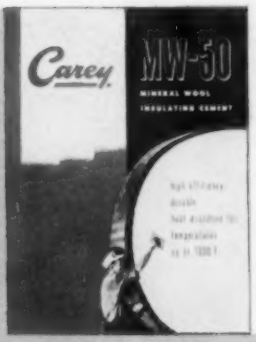
- oil or gas pipelines
- processing operations
- refinery construction or maintenance...

You need this helpful literature!

Asbestos pipeline felt data book...

a discussion of protective coatings for pipelines by a competent corrosion engineer. Covers the fundamentals of low cost, dependable pipeline protection. Timely, informative, fully illustrated.



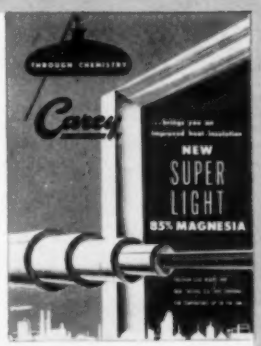


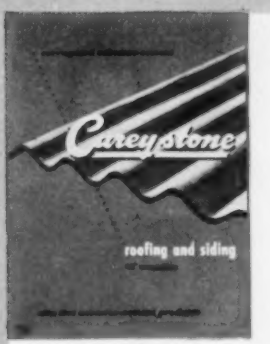
Carey MW-50 data book...

describes the most modern method for insulating all types of heated equipment having temperature ranges up to 1600°F., and gives details for applying insulation on irregular or hard-to-reach surfaces.

Super-Light 85% magnesia data book...

description, specifications and recommended uses for a new, improved insulation in precision-sized monolithic blocks, molded pipe coverings and cements.





Careystone corrugated asbestos-cement roofing and siding data book...

technical data, application details and specifications covering the economical use of Careystone asbestos-cement for all types of buildings.

Get the Carey Data Books you need absolutely free. Ask your Carey Industrial Sales Engineer, or just fill in coupon and mail today. No obligation!

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PRODUCTS

THE PHILIP CAREY MFG. CO., LOCKLAND, CINCINNATI 15, OHIO
IN CANADA: THE PHILIP CAREY CO., LTD. 277 DUKE ST. MONTREAL 3, P.Q.

The Philip Carey Mfg. Co.
Lockland, Cincinnati 15, Ohio
Department PP-10

Gentlemen: Please send me without charge the Carey Data Books on ☐ PipelineFelt ☐ Super-Light 85% Magnesia Insulation ☐ MW-50 Cement ☐ Careystone Asbestos-Cement Roofing and Siding. Place check mark in box before Data Books wanted.)

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Company _____

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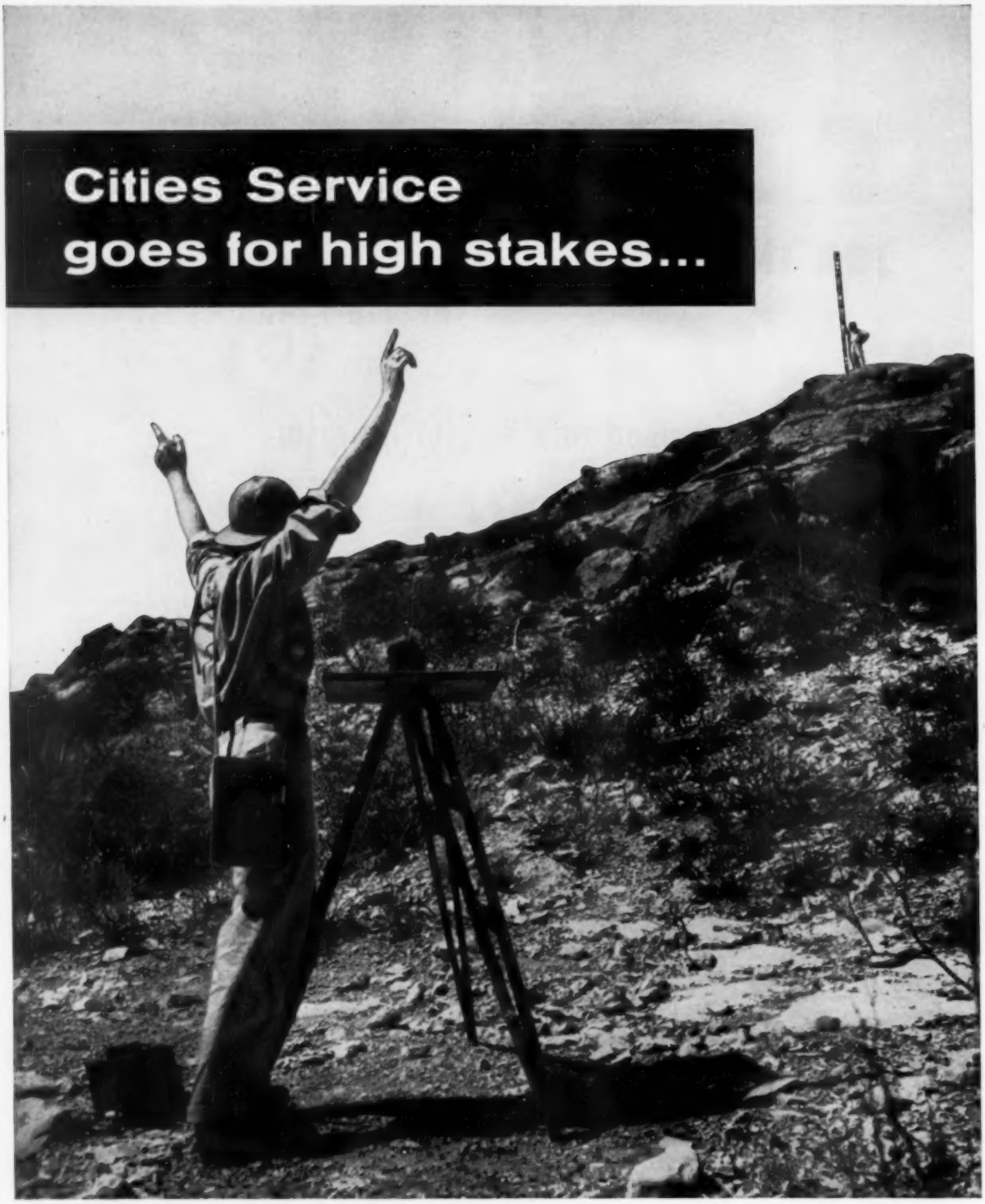
Position _____

City _____ Zone ____ State _____

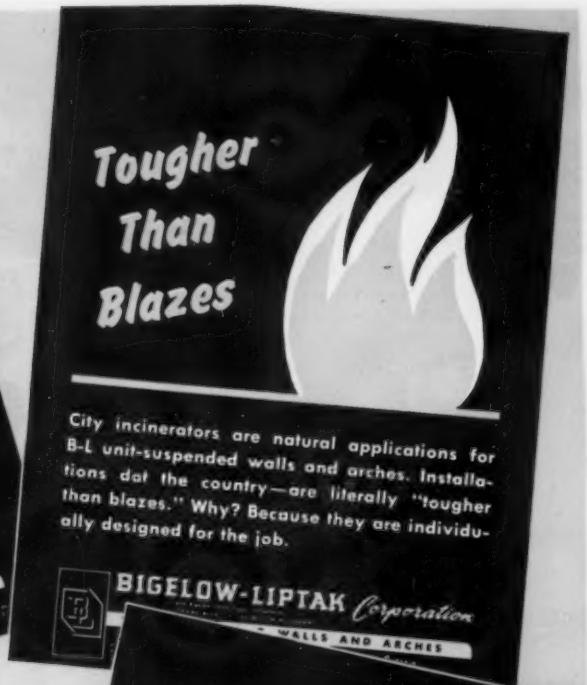


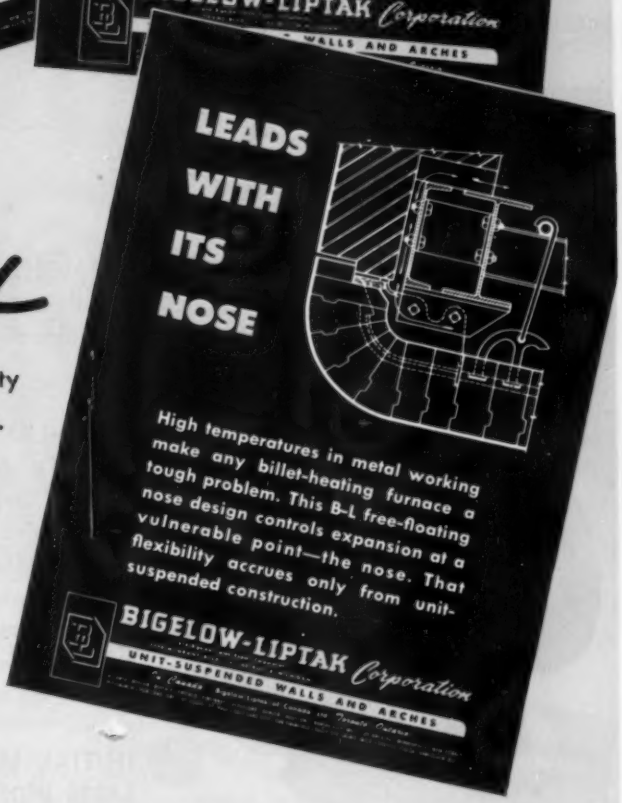
Test wells are put down on an average of one every 4 days by

CITIES SERVICE

A Growth Company

King Size
BOILERS
Big boilers for utilities and general manufacturing? B-L's tube supported wall design and Texad* finishes eliminate enclosure structural steel and steel plate casings. That saves plenty on the original cost! Performance? Better than ever!
BIGELOW-LIPTAK Corporation
UNIT-SUSPENDED WALLS AND ARCHES


Tougher Than Blazes
City incinerators are natural applications for B-L unit-suspended walls and arches. Installations dot the country—are literally "tougher than blazes." Why? Because they are individually designed for the job.
BIGELOW-LIPTAK Corporation


LEADS WITH ITS NOSE
High temperatures in metal working make any billet-heating furnace a tough problem. This B-L free-floating nose design controls expansion at a vulnerable point—the nose. That flexibility accrues only from unit-suspended construction.
BIGELOW-LIPTAK Corporation
UNIT-SUSPENDED WALLS AND ARCHES

Versatility

You'll find that versatility is an inherent quality in B-L's design for furnace walls and arches. Thermal problems—erosion hazards—desired end results—are factors that govern the final design. That's why you see so many B-L installations through industry. After all, they provide long, dependable service at a low, low cost. More information? Write today.

*REGISTERED TRADE MARK

BIGELOW-LIPTAK Corporation

AND BIGELOW-LIPTAK EXPORT CORPORATION
2550 WEST GRAND BOULEVARD, DETROIT 8, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MINNEAPOLIS • NEW YORK
PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

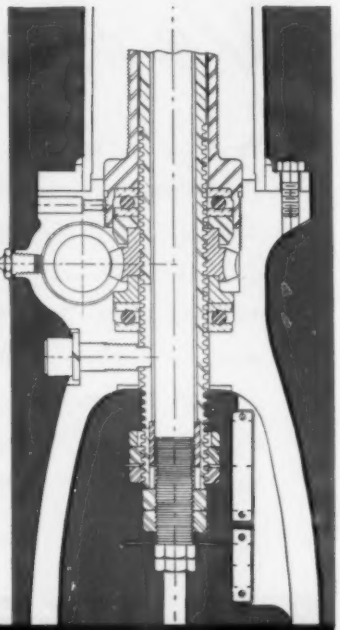
The Beauty of Functional Design

IN THE **HAMMEL-DAHL**

CONTINUOUSLY CONNECTED HANDWHEEL...

Achieved by integrating parts in the ***compact, completely enclosed*** gear housing illustrated below.

- STRAIGHT-LINE LIFT—No side thrust is exerted against the valve stem.
- COMPLETELY UNHAMPERED AUTOMATIC OPERATION—Permits limiting of valve lift if desired—but in the neutral position the handwheel mechanism offers *no resistance* to valve stem movement.
- INITIAL LUBRICATION LASTS INDEFINITELY.



COMPLETE Information in H-D Bulletin 109-A

HAMMEL-DAHL COMPANY

H-D 175 POST ROAD, (WARWICK) PROVIDENCE 5, R. I., U. S. A. H-D

SALES OFFICES IN ALL PRINCIPAL CITIES

MANUFACTURING PLANTS IN WARWICK, R. I., U. S. A., CANADA, ENGLAND, FRANCE AND HOLLAND

CANADIAN MANUFACTURING AFFILIATE—GUELPH ENGINEERING CO., GUELPH, ONT.

—to protect the quality of your gasoline

On-the-spot technical assistance helps you take full advantage of Tenamene

Inhibitor response is closely tied to many variables. These include the nature of the crude, the character of the stock fed to cracking units, operating conditions, equipment performance —even employee carelessness.

Proper and economical use of inhibitors depends on quick adjustments to these changing conditions. On-the-spot service often is a "must."

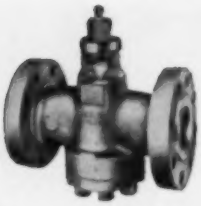
As the producer of the Tenamene additives, Eastman is ready with that service whenever and wherever you need it. Highly qualified men are less than 24 hours away, ready to make your refinery their headquarters whenever a problem arises.

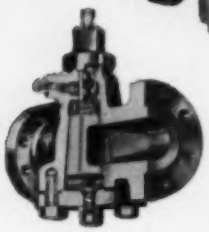
For more information on Tenamene additives and the interested technical service that backs up their proper use, contact our local representative or write to Eastman Chemical Products, Inc., Kingsport, Tennessee—a subsidiary of Eastman Kodak Company.

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tenn.; New York—260 Madison Ave.; Framingham, Mass.—65 Concord St.; Cincinnati—Carew Tower; Cleveland—Terminal Tower Bldg.; Chicago—360 N. Michigan Ave.; St. Louis—Continental Bldg.; Houston—412 Main St. **West Coast: Wilson Meyer Co.;** San Francisco—333 Montgomery St.; Los Angeles—4800 District Blvd.; Portland—520 S. W. Sixth Ave.; Seattle—821 Second Ave.

Tenamene
EASTMAN GASOLINE ADDITIVES

 (To obtain more data on advertised products see page 1620)

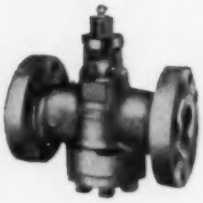
THIS  is a remarkable valve, as

 Lubricant goes in through

grooves in the plug and body

three things—it lubricates the seat

acts as a hydraulic jack to keep the

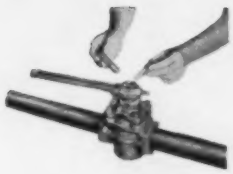
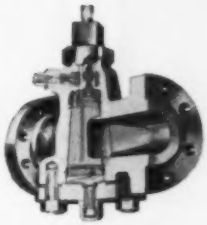
this valve  is safer, because it can

because lubricant stops seepage

because, by eliminating friction

most valves. What kind of valve is it?

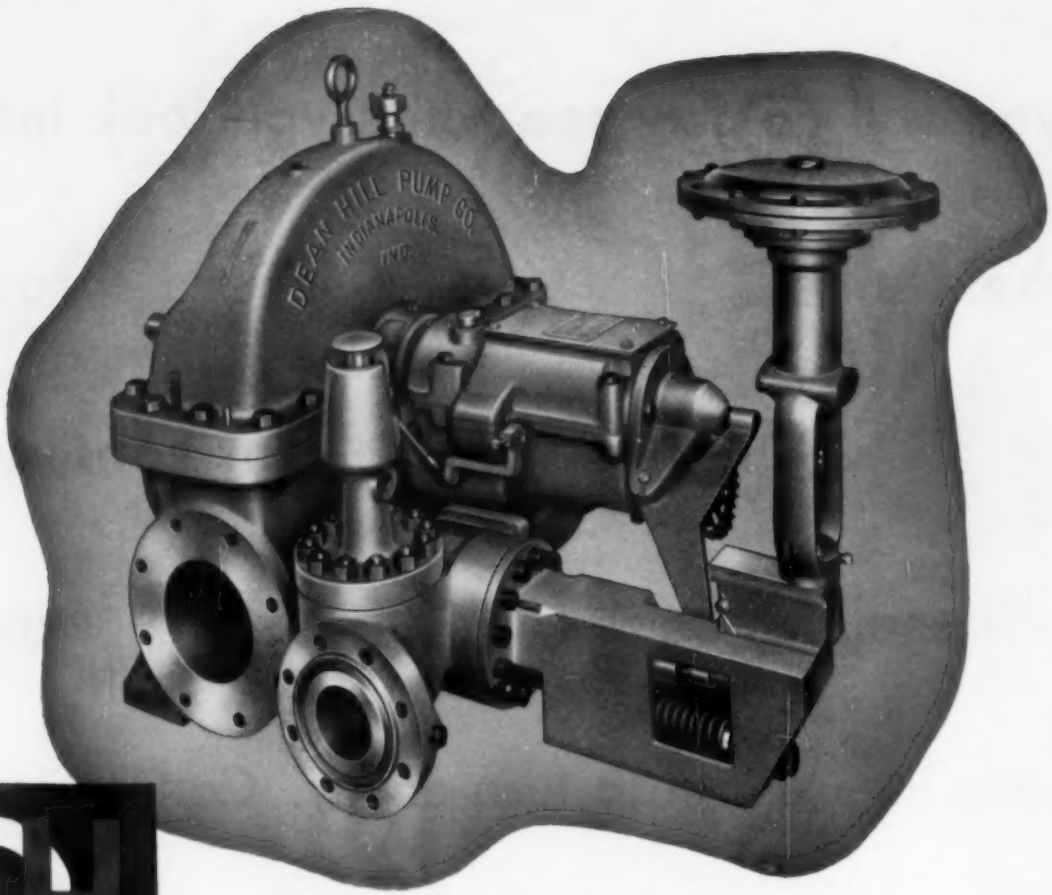
by **ROCKWELL** Manufacturing Company,

you will quickly see when you look inside the stem  and is forced through  .. In service, this lubricant does —it seals off the seating area .. .and it plug in position to turn easily. Consequently always be operated in an emergency, and, before it starts. It's also more economical and abrasion, lasts much longer than

Naturally, it's **ROCKWELL-NORDSTROM,**

Pittsburgh 8, Pennsylvania.

Canadian Licensee:
Peacock Brothers Limited



D-H turbines with pressure regulators solve constant fluid pressure problems

Dean Hill Turbines equipped with pressure regulators are "made to order" for boiler feedwater applications requiring precise, automatic pressure control. Regulators can be used with any turbine model of either horizontal or vertical design and are furnished with direct-acting or remote control. They can be arranged to maintain a constant pump discharge pressure or a constant differential pressure over the boiler pressure.

The regulator controls all turbine speeds up to normal rating, but above this point the turbine governor overrides the regulator to prevent overspeeding. The emergency trip valve remains independent.

To effect maximum efficiency of control and eliminate lost motion and deflection, the regulator is mounted on a rugged support made of welded six-inch channels.

For further information on D-H Turbines and optional accessories

write today for Catalog 300.

DEAN HILL PUMP COMPANY

Pump and Turbine Engineers Since 1893

Indianapolis 7, Indiana

Sales Offices In:

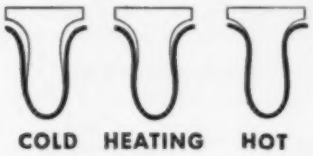
Chicago, New York, San Francisco, Boston, Cincinnati, Denver, Albuquerque, El Paso, Salt Lake City, New Orleans, Philadelphia, Tulsa, Los Angeles, Pittsburgh, Houston, Dallas, St. Paul, Toledo, Cleveland, Grand Rapids, Birmingham, Ala., Louisville, Memphis, Richmond, Mexico City, Montreal, Reading, Pa., The Hague, Washington, Charlotte, Casper, Wyo., Knoxville.

Badger

Expansion JOINTS

Typifying Joint Engineering at its Best

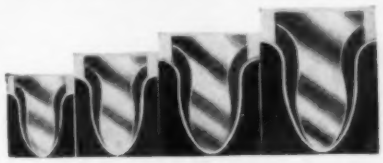
LONG-LIFE FEATURE

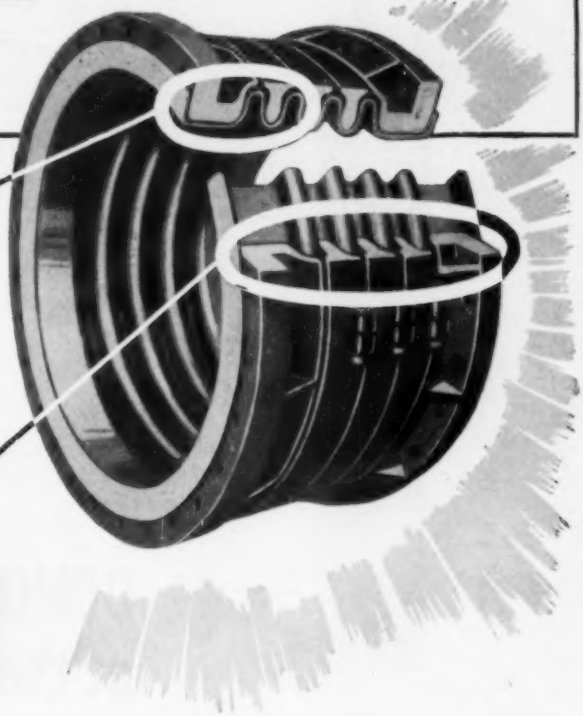


the ALL-CURVE, directed flexing, corrugation.*

LONG-LIFE FEATURE

PROPORTIONAL DEPTH of corrugation for each range of diameters and traverse.**





Badger Directed Flexing Self-Equalizing Expansion Joints give exceptionally long service life, proof of which has been well established in the City of New York where more than 4,000 of these Badger Joints are installed in the underground steam lines of the largest district heating company in the world.

*** The exclusive all-curve directed flexing corrugations and matching equalizing rings distribute the flexing stresses over the entire area of all corrugations.**

**** For each range of diameters there is a carefully calculated depth of corrugation with a defined limit of traverse.**

Each Badger Expansion Joint is originally designed with the proper number and depth of corrugations for maximum flexibility and service life at full rated traverse.

Remember — when you want long trouble free service in your distribution system, there is no substitute for the proper number and depth of corrugations. COMPARE BEFORE YOU BUY and to be sure you get the best, specify "BADGER".

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE • MASS.

 (To obtain more data on advertised products see page 1620)

DEMONSTRATION... at the API Meeting!

The new Gilbarco Electronic Tank Gauge will be demonstrated *in actual operation* at THE API MEETING in Chicago. Nov. 7-11.

Place: Conrad Hilton Hotel
Suite: 826-A
Time: At your convenience

As a new, effective means of controlling inventories and stock losses, this new development of *electronic* measurement merits your close inspection. Drop in at Suite 826-A at any time.

OPENING NEW HORIZONS IN ACCURACY!

Now tank farms and refineries can maintain at least 100% greater accuracy with the new Gilbarco Electronic Tank Gauge. *No other tank gauge today* offers all these advantages for liquid measurement:

★ **Accurate** to 1/16 of an inch.

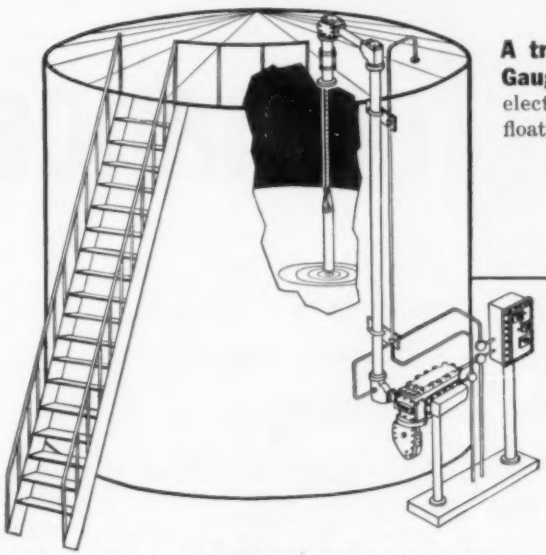
★ **Exterior Installation** and maintenance, without taking tank out of service.

★ **Not affected** by variations in specific gravity or viscosity.

★ **Can be used** in any type of low pressure tank.

★ **Can be supplied** with automatic switches and an instrument to indicate the average temperature of the product.

★ **Remote reading** equipment available for accurately transmitting temperature and liquid level data.



A truly Electronic Tank Gauge – actually *measures* electronically, not with a float!

For assured accuracy... get all the facts on the new Gilbarco Electronic Tank Gauge today!

GILBERT & BARKER MANUFACTURING CO.
West Springfield, Mass.

Please send us complete information on the Gilbarco Electronic Tank Gauge.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

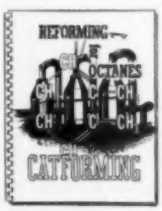
Gilbarco

West Springfield, Mass.
Toronto, Canada

CATFORMING *means*

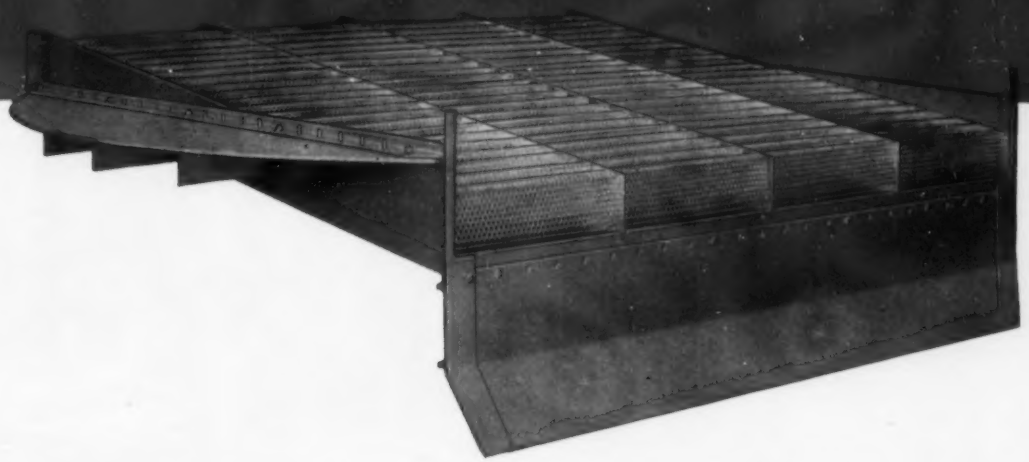
High Octanes...
High Yields...
Low Cost...
Proved Performance

These advantages of Atlantic Catforming are being demonstrated again and again in different commercial installations. We invite you to share in the benefits of Catforming. Please phone, write or wire for our detailed brochure, "CATFORMING." The Atlantic Refining Company, Research and Development Dept., P. O. Box 8138, Philadelphia, Pa.



ATLANTIC *It's the Catalyst that counts*

"Extraordinary Performance Is Routine" with KASKADES



CASE HISTORY No. 1...

One refiner was operating a 7.5' vacuum tower which was limiting capacity and yields due to the pressure drop of existing bubble trays. Capacity desired was:

Vapor....24,600 #/hr of 0.0137 #/cf density
Liquid.....36,400 #/hr of 58.3 #/cf density

This refiner replaced the bubble trays with "Benturi" Kaskade trays on the same supports, and is now obtaining a pressure drop of less than 1.0 mm hg pressure drop per tray.

CASE HISTORY No. 2...

An engineering firm recognized a pressure drop problem with a process duty equivalent to:

Vapor.....35,500 #/hr of 0.26 #/cf density
Liquid.....965,000 #/hr of 62.4 #/cf density

Yet, multi-pass "Benturi" Kaskade trays in a 7.5' diameter column gave them less than 2.0 mm pressure drop per tray.

Whether your problem is extraordinary or routine, the design flexibility "Benturi" Kaskade tray is probably your answer to greater capacities and higher efficiencies. Wire, write or phone us on its application to your fractionating problem, there's no obligation.

KOCH ENGINEERING COMPANY, INC.

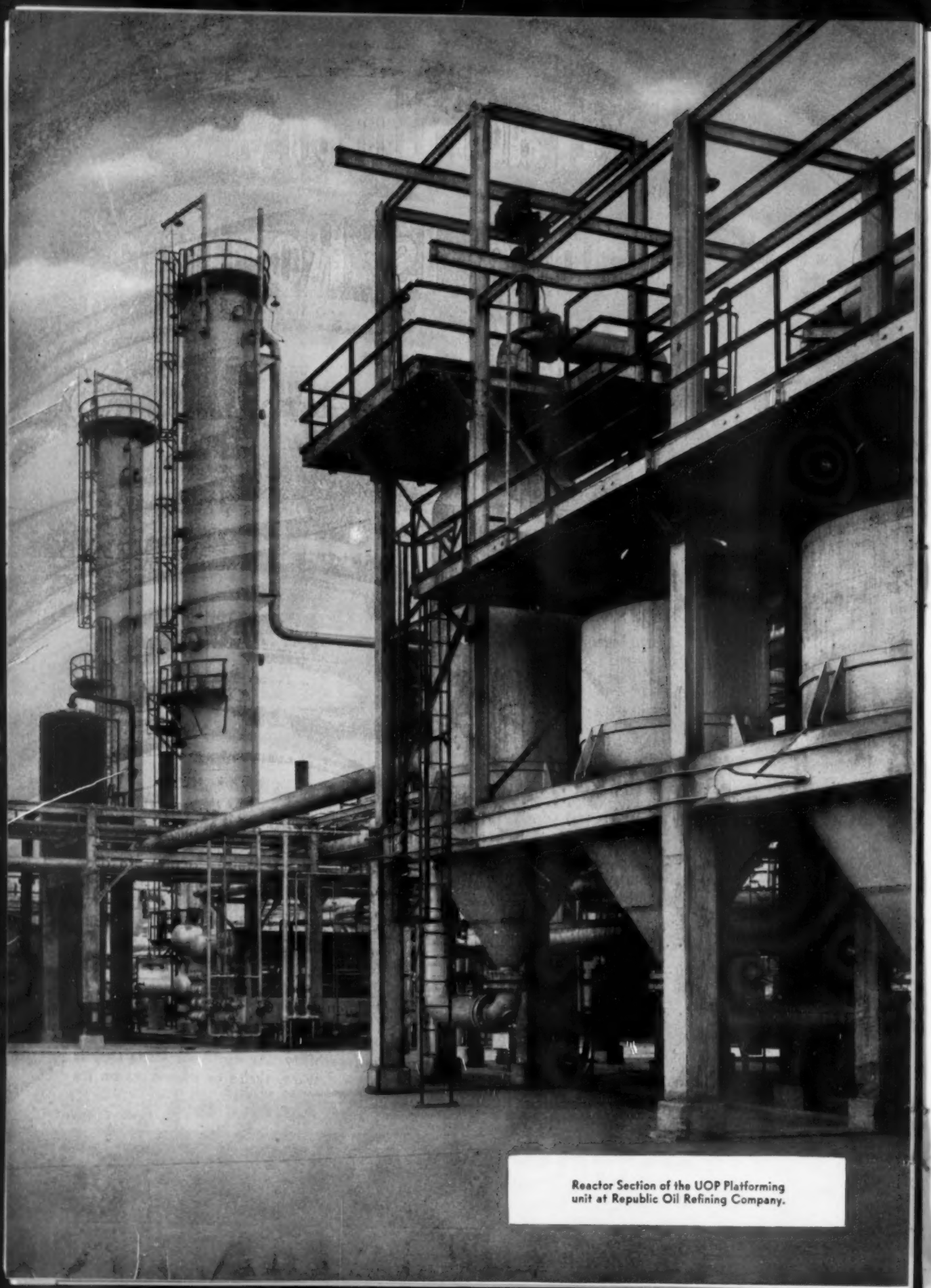
DESIGNERS • MANUFACTURERS • BUILDERS
321 WEST DOUGLAS • WICHITA 2, KANSAS

Eastern and Export
30 Rockefeller Plaza
New York City

Pittsburgh, Pa., Repr.
D. D. Foster Co.
412 Peoples Gas Bldg.

Tulsa, Okla., Repr.
Myers-Bogwell Co.
Wright Bldg.

Koch International
10 Rue Auber
Paris, France



Reactor Section of the UOP Platforming unit at Republic Oil Refining Company.

Advertisement

Platformer Helps Republic To Meet Changing Market Demands Quickly, Economically

By L. W. Robbie
Vice President and General Manager
Republic Oil Refining Co., Texas City, Texas

ADDITION of a UOP Platforming unit to our Texas City refinery has made it possible for Republic Oil Refining Company to quickly fill demands for a variety of products, thus enabling us to easily meet changing market conditions while at the same time deriving the maximum possible profit from the plant's throughput.

L. W. Robbie

The decision to add a catalytic reforming unit to our processing equipment was made only after we took a long-range look at the industry and decided that important changes in octane requirements and public demand for certain petroleum products and by-products would occur. We chose Platforming because:

(A) Careful comparison of other refiners' operating data, and Platforming's long record of commercially proved experience indicated that it was best suited to our anticipated needs.

(B) We felt the simplicity of the Platforming process would assure trouble-free operation and minimum costs.

(C) It would give us flexibility to switch from production of motor fuel to aromatics without costly revamping of equipment.

(D) In addition to increasing octane numbers, the overall quality of our finished gasoline would be improved in other ways.

Can Switch to Aromatics

Now that the Platformer has given us the flexibility that previously was lacking in our refinery operations, we are in a more favorable position to increase octane numbers quickly should the demand swing upward, or we can switch to the production of aromatics at times when market conditions justify.

The 5,500 B/SD Platformer went on stream last November 12, and it has been operating at capacity since then. Catalyst life reached 73.11 barrels of charge per pound of catalyst on the initial run. So far, we have been producing only motor fuel, with the Platformate ranging up to 89 clear octane and 98½ octane after the addition of 3 cc. TEL. The high quality of the Platformate has enabled us to meet with ease the market demands in our trade territory, which call for 87 octane regular gasoline and 95 octane premium motor fuel.

Universal Oil Products Company designed, engineered and licensed the Platformer. Construction of the unit and revamping of some existing refinery equipment was done by Procon Incorporated.

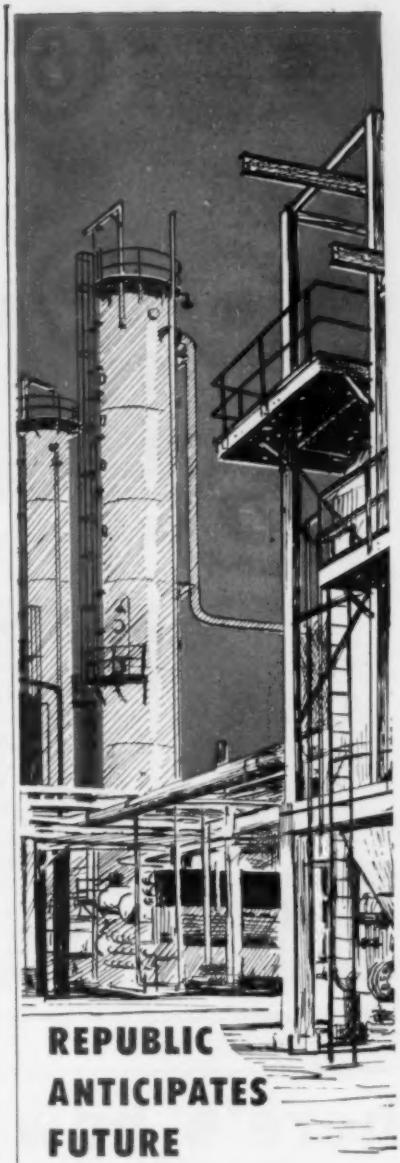
One of the unusual features of the unit is the location of an overhead cooling system for the depentanizer and rerun towers on the roof of an old pump house. The interior of the old pump house was revamped and the Platformer's control panel facilities were placed there. Only one-half of the roof area is occupied by the cooling facilities, thus leaving considerable space for the installation of other equipment should the need arise at some later date for expansion of the unit. A start in this direction was made at the time the Platformer was built by installing a fourth reactor in anticipation of the possible production of aromatics.

21,000 B/SD of Gasoline

Our Texas City refinery can turn out in excess of 21,000 barrels of gasoline per stream day through the combined output of the Platforming unit, a UOP Fluid Catalytic Cracking unit and a UOP polymerization plant. The cat cracker was operated during World War II to produce 100 octane gasoline for the Armed Forces. We conservatively estimate that 85 per cent of our total gasoline production will lead up to more than 95 octane.

Twenty different Gulf Coast sweet crudes are processed in the refinery, which has a throughput capacity of 43,000 B/SD. Charge stock to the Platforming unit boils in the range of 220 to 400° F., and it is a heavy straight run gasoline fraction prepared in a separate fractionation section.

With the installation of the Platforming unit, we have climaxed a long-range program designed to produce the highest quality products which have the broadest marketable range. Our Texas City refinery now is one of the most modern in the country, and the Platformer is playing a vital role in helping us to achieve our goal of making greater volumes of higher quality products from petroleum.



REPUBLIC ANTICIPATES FUTURE OCTANE NEEDS WITH UOP PLATFORMER

designed, engineered and licensed by

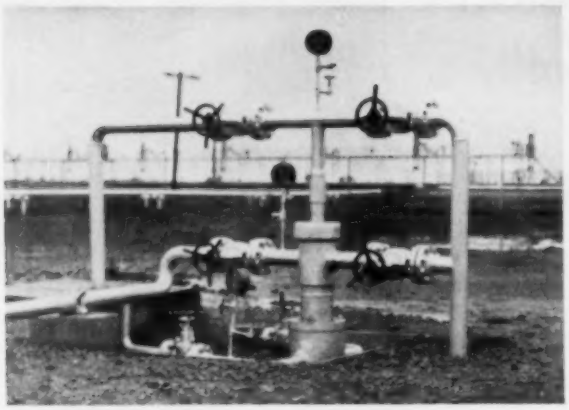
UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD,
DES PLAINES, ILL., U. S. A.
Laboratories: RIVERSIDE, ILLINOIS

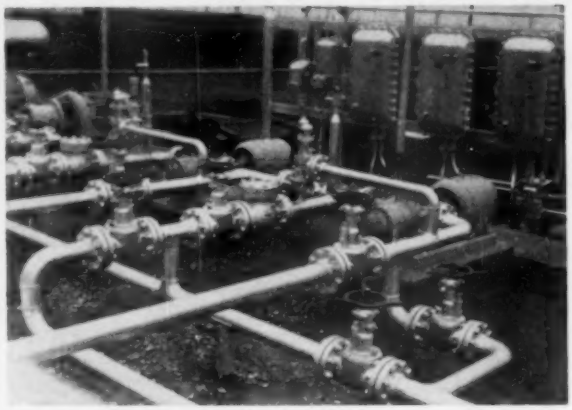
Universal Service
Protects Your Investment

 (To obtain more data on advertised products see page 1620)

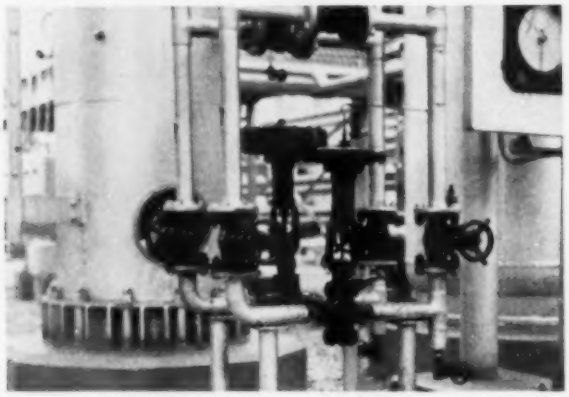
look where ORBIT VALVES are serving



Surface installations over propane underground storage well in Kansas.



Suction and discharge propane and water lines at underground storage project in Kansas.



Blending tanks. Blending 18 lb. gasoline up to 38 lbs. vapor pressure.

Manifold dome — propane surface storage.

here's how ORBIT VALVES can help reduce your operating costs

Orbit Forged Steel LP-Gas Valves are *vapor tight* because:

- The body and bonnet are made of drop forged steel which greatly increases the density of the metal.
- The bonnet is welded to the body. This eliminates leaks that sometimes occur in bolted bonnet type valves.
- The stem packing chamber is equipped with adjustable plastic packing that can be added to if necessary while the valve is in service and under pressure.
- A positive seat shut-off through Orbit's principle of friction free seating.

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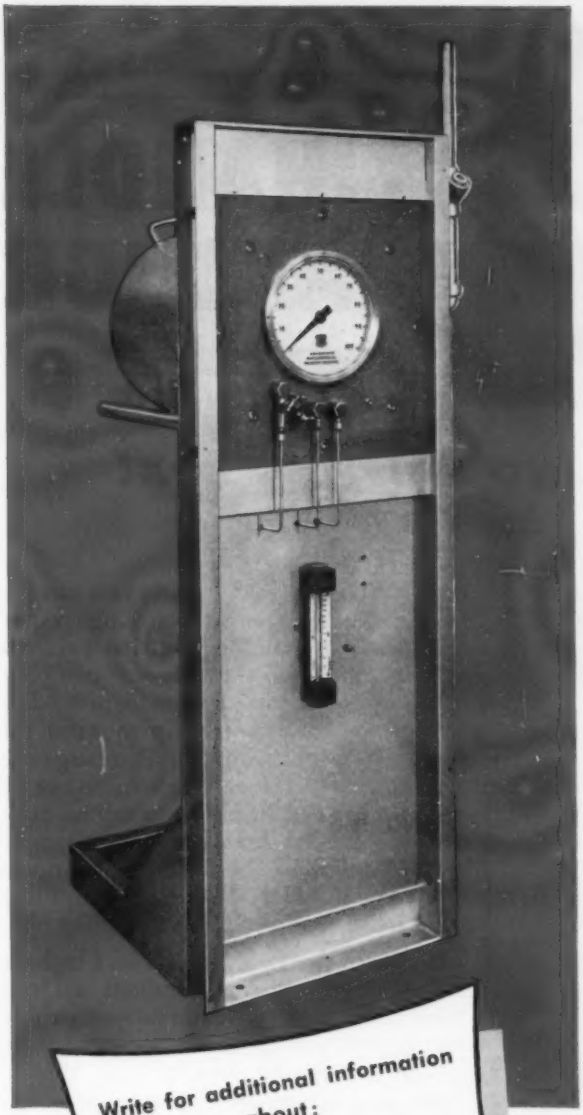

PHILLIPS 66 DIFFERENTIAL REFRACTOMETER

. . . provides continuous, reliable analytical data for automatic adjustment of process or blending controls.

- ***Increases output***
- ***Improves quality***
- ***Cuts operating expense***

The Phillips *66* Differential Refractometer keeps controls adjusted automatically. You can get reliable indications of changes in index of refraction to 0.00001 unit or better. Sensitive analytical controls . . . with minimum time lag . . . make immediate adjustments to insure uniform quality levels. Specified purity, uniformity and maximum output are maintained automatically. The Refractometer may be situated outdoors or inside the plant control room.

Phillips Petroleum Company's broad experience in sampling procedure and automatic control application is at your service through our Instruments Sales Division.

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Other analytical and process control instruments and devices

Phillips 66

INSTRUMENTS SALES DIVISION

PHILLIPS PETROLEUM COMPANY

Bartlesville, Oklahoma

(To obtain more data on advertised products see page 1620)

Bingham STUFFINGBOXLESS PUMPS

HANDLE AT HIGH

FIREPROOF AND EXPLOSION-PROOF! Leakage of vapor or liquid to atmosphere or leakage from outside into pump is *impossible*. Not only is plant and personnel protected, but loss of valuable pumpage is prevented. Type KC High-Pressure Single-Stage Stuffingboxless Pump illustrated.

NO STUFFING BOX! NO PACKING!

Bingham Stuffingboxless Pumps are successfully handling liquids having high vapor pressure, requiring high suction pressure and, frequently, abnormally low pumping temperature (—300° F). Standard models handle suction pressures up to 2,000 psi (higher pressures available). Pumping temperatures to 850° F and higher also can be handled. These conditions present no difficulty for Bingham Stuffingboxless Pumps, but they are difficult and sometimes impossible to meet with conventional pumps due to limitations imposed by the stuffing box.

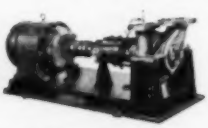
Because there is *no stuffing box*, Bingham Stuffingboxless Pumps eliminate all the disadvantages of conventional pumps operating with stuffing boxes equipped with packing or mechanical seals.

Bingham Stuffingboxless Pumps are in service today all over the world, with distinguished records in reliability, continuity of service, and low maintenance. Write to your nearest Bingham office for Bulletin 107 or for additional information.

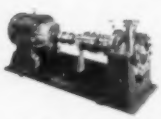
***And other volatile liquids.**

TYPICAL BINGHAM "DOUBLE VOLUTE"

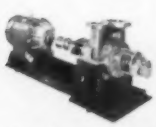
The Bingham Type HPD "Double Volute" Multi-Stage Double Case "Hi-Press" pump for extremely high pressure service.



Bingham Type CAD "Double Volute" Single-Stage Process Pump.

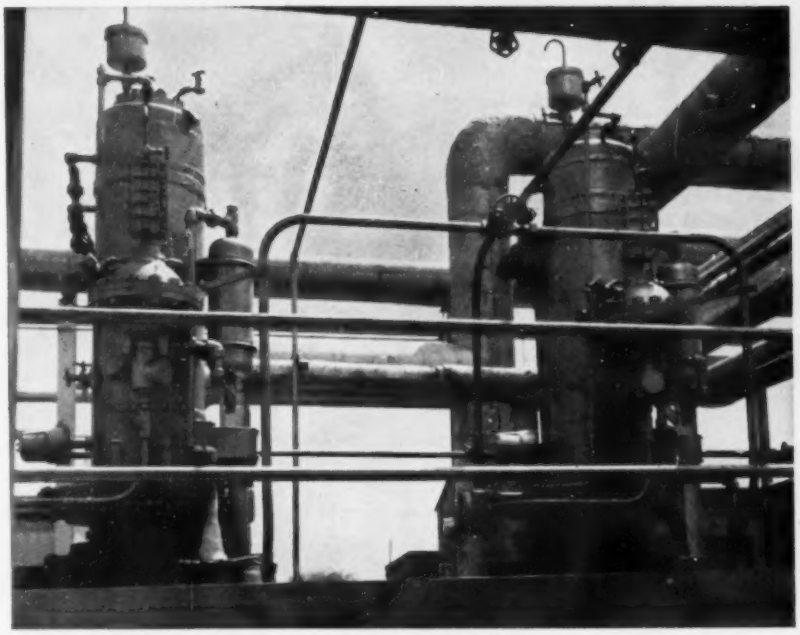


Bingham Type CJ "Double Volute" Two-Stage Process Pump.



Bingham Type CD "Double Volute" Double Suction vertically-split case pump for hot service.

LIGHT HYDROCARBONS* SUCTION PRESSURES



Battery of Bingham Stuffingboxless Pumps handling light hydrocarbon at low temperature, under high suction pressure. Tennessee Gas Transmission Co. plant, Gabe, Kentucky.

Bingham PUMPS
SINCE 1921
DOUBLE VOLUTE RADIAL BALANCE

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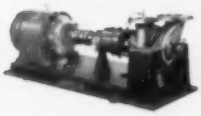
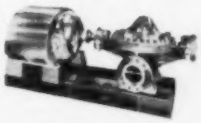
PUMPS FOR PETROCHEMICAL SERVICE

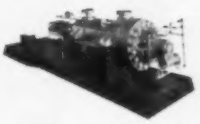
Bingham Type CM "Double Volute" vertically split case two-stage pump for hot service.



A Bingham Type CKA "Double Volute" Single Stage Koke-Krusher for coke-laden pumpage.



Bingham Type HSB "Double Volute" Double Suction Pump for high heads.

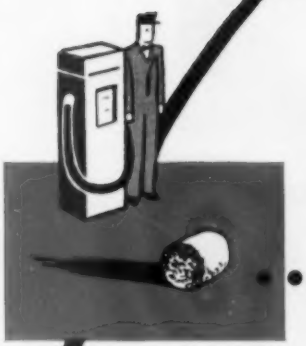


Bingham Type CP "Double Volute" Multi-Stage, Double-Case pump for hot or cold service.

Bingham Type VCP Vertical Pump for low NPSH conditions, featuring bottom dismantling.

(To obtain more data on advertised products see page 1620)

with ATLANTIC



...it's the catalyst that counts!

The Davison Chemical Corporation has teamed with The Atlantic Refining Company in the development of a catalyst for reforming straight run and cracked gasolines to a product of higher octane level. Among the important tasks delegated to Davison was the translation of this catalyst from laboratory to commercial production and at the same time impart optimum selectivity, stability, ruggedness and regenerability.

Today, Davison is producing Atlantic Platinum Reforming Catalyst on a commercial scale and shipments are being made at an increasing rate to licensees of the Atlantic Catforming Process. Davison has an outstanding record of this type of development in many fields of commercial catalyst production. If you have a catalyst problem, see your Davison Field Service Engineer or write.

Progress Through Chemistry

DAVISON CHEMICAL COMPANY

Division of W. R. Grace & Co.

BALTIMORE 3, MARYLAND

PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, TRIPLE SUPERPHOSPHATE, PHOSPHATE ROCK, SILICA GELS AND SILICOFLUORIDES. SOLE PRODUCERS OF DAVCO GRANULATED FERTILIZERS

Lectrodryers
TRAP HARMFUL MOISTURE BEFORE IT REACHES AIR LINES

DRY air protects against freeze-ups and prevents harmful moisture from causing sludge or rust that may clog delicate instrument orifices. DRY air insures a clean, free flow to finely balanced controllers, valves and instruments . . . actually reducing maintenance problems.

Prevent harmful moisture condensation in air lines and obtain a flow of clean, DRY air by installing a Lectrodryer* and a Lectrofilter* at your air compressor. The filter frees the air of oil and grime after it leaves the compressor. The Lectrodryer continuously and automatically DRYs the air to dewpoints as low as − 100°F, depending on your need.

Investigate the new "BY" Lectrodryers. They're designed especially for instrument air service. They contain no moving parts, assuring minimum maintenance. And their DRYing adsorbent, Activated Aluminas, will not wear out.

Write for the booklet *Because Moisture Isn't Pink.* It describes Lectrodryers and how industries are using them. We will welcome any inquiry you might have regarding DRYness engineering. Pittsburgh Lectrodryer Corporation, 332 32nd St., Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
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LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.

ATTAPULGUS Fullers Earth

POROCEL Activated Bauxites

...reliable sorptive minerals for petroleum and chemical processing

WANT TO PURIFY BY ADSORPTION?

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils; chemicals and petrochemicals.

HAVE CATALYST OR CATALYST CARRIER NEEDS?

Our sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.

WHAT DO YOU WANT TO DRY?

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

SPECIAL GRADES

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs are ready to assist in research, development, design and operating problems. Your inquiries are invited.

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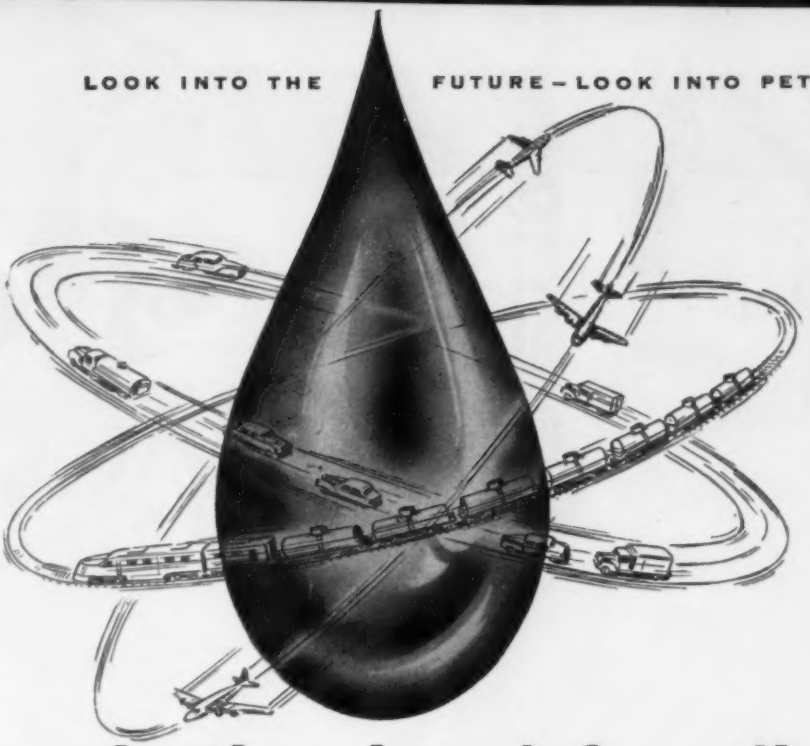
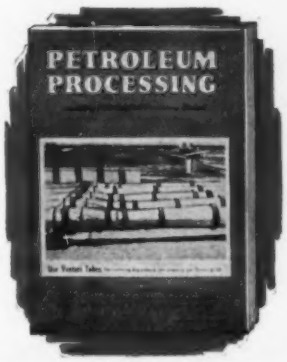
LOOK INTO THE FUTURE—LOOK INTO PETROLEUM PROCESSING



what's ahead for oil—and you?

Petrochemicals, the fast growing offspring of the world's fastest changing industry, will make a tremendous new market for all process equipment in the next ten years. Write for free plant directory and market information.



PETROLEUM processing is an industry constantly building a new plant to make new products for fast changing markets. Obsolescence is more rapid than in any other major industry. Today it is geared to mass production of high octane gasoline for 10:1 ratio automobile engines. Tomorrow it will be making rocket fuel, new jet fuels, and synthetic fuels if necessary. The industry moves fast, thinks big and spends big.

If you make process equipment, components for process equipment or materials which can be used in petroleum processing, you should concentrate your sales and advertising effort on this industry for the next ten years. It will be the biggest market for processing equipment. To sell your product to refineries you need specialized sales attention—salesmen and engineers who really know the complex industry and its many problems. To do a real advertising job you need a specialized publication geared to that industry.

Petroleum Processing is preferred by more of the real buying factors in these important buying elements of the industry: Plant engineering and maintenance staffs . . . Plant process design engineers . . . Home office engineers . . . Research and development personnel . . . Engineering and construction firms.

Petroleum Processing has the balance editorially to serve all these elements. It is the only publication that has the quantity of circulation needed to cover all branches (36% more than the effective circulation of the second publication). It has the backing of a great business paper publisher to keep it ahead of the world's fastest changing industry. To sell more process equipment in the ten big years ahead—advertise for those sales, NOW, in *Petroleum Processing*.

PETROLEUM PROCESSING

NOW
A McGRAW-HILL PUBLICATION

330 WEST 42ND STREET, NEW YORK 36, N. Y.

How far *was* Thirty Paces?

NOBODY knows, exactly. Back in the days of meetings on the "field of honor" neither the distances nor the weapons were very accurate. Land and buildings were sometimes "paced off" and even some phases of engineering followed the rule of thumb.

In the 49 years since Arthur G. McKee & Company was founded, *accuracy* has been the outstanding characteristic of our activities. Not just accuracy in measuring feet and inches but accuracy in determining the correct design for your plant—accuracy in its engineering and construction, accuracy in the selection and installation of equipment and controls.

The McKee organization makes a scientific approach to the problem of designing and constructing your new plant to earn a profit for you.

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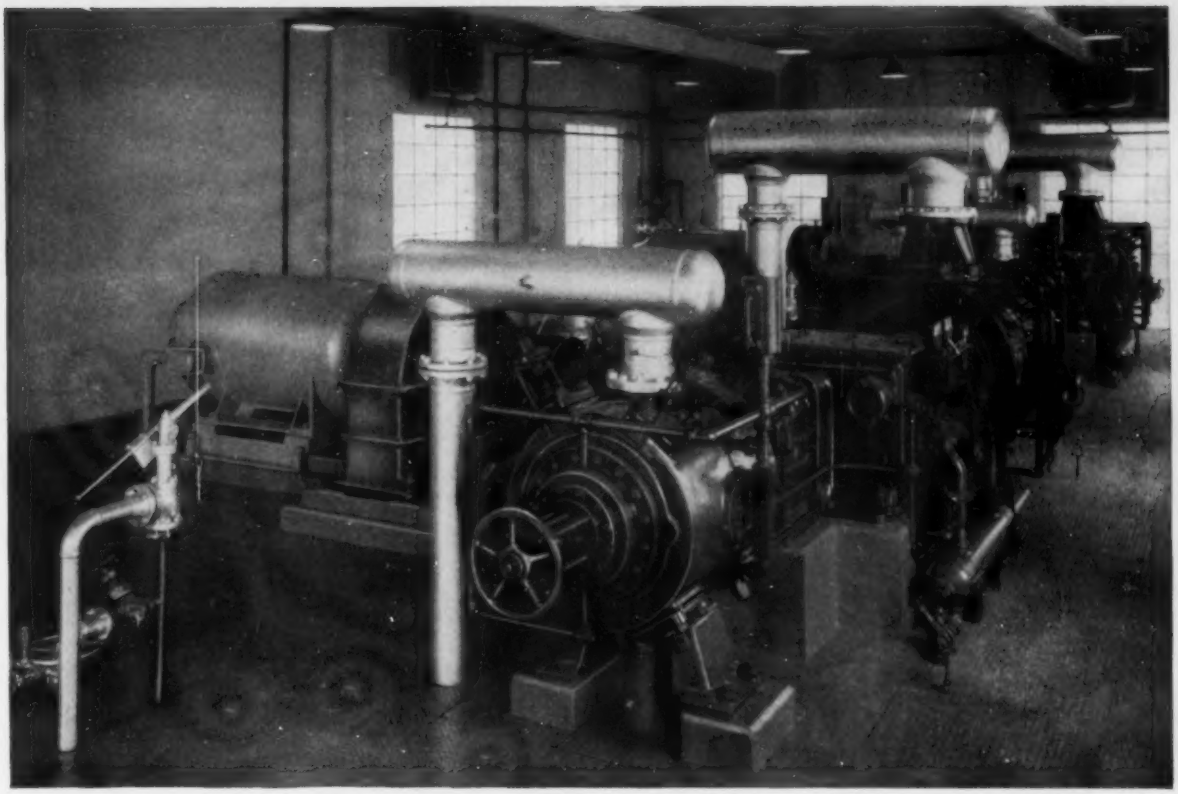
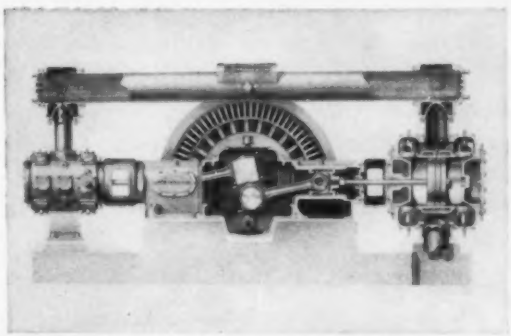


LINEUP OF WORTHINGTON 2-cylinder gas compressors at Frontier Oil's new Tonawanda (N.Y.) refinery. Units are rated at 600 hp each.

Frontier's new refinery gets Worthington compressors



CUTAWAY VIEW of Worthington balanced-opposed compressor. Note low silhouette, modest foundation requirements, and double-throw crankshaft which permits as many as four pairs of cylinders to be arranged on single compressor frame.

At Frontier Oil Refining Company's big new refinery in Tonawanda, N.Y., two Worthington type BDC-2 balanced-opposed gas compressors have gone to work in the two stage compression of hydro-carbon gas mixtures. By selecting Worthington units, Frontier made sure of:

Smooth, vibrationless operation. Two throw crankshaft with cranks set at 180 degrees gives opposed piston action.

Low-cost installation. Packaged design provides quick and easy field assembly. Lack of vibration permits location on small foundation.

In chemical plants and general industrial installations, these Worthington units are paying off in dependable operation. You can use practically any type of drive to power them. Like all Worthington compressors, they are equipped with the exclusive Feather* Valve — lightest, tightest, most efficient valve made.

Remember, no matter what your capacity or pressure requirements may be, there's a compact Worthington steam- or motor-driven compressor to fill the bill. Write Worthington Corporation, Compressor Division, Section K.3.5, Buffalo, N.Y. K.3.5

* *Reg. U.S. Pat. Off.*

"SEE the Worthington Corporation Exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 41st Street."

WORTHINGTON

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Balanced-Opposed • Direct Connected • Gas Engine

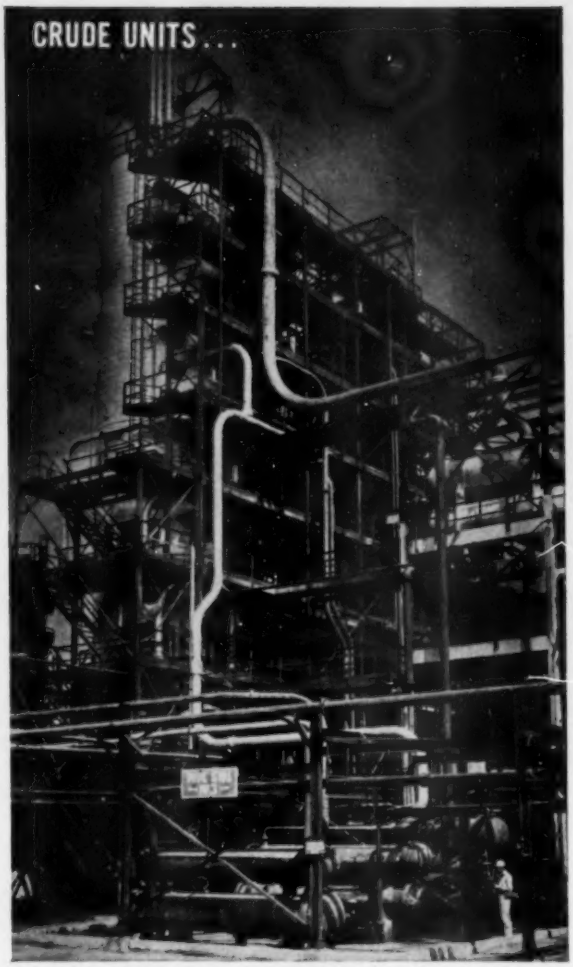
POLYRAD CONTROLS ACID CORROSION

all around the refinery

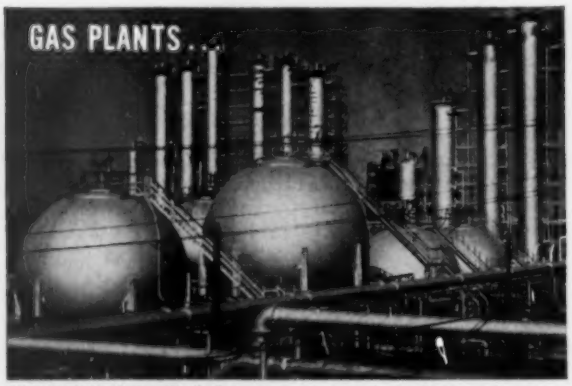
From crude units to gas plant areas, Hercules Polyrad controls corrosion, helps maintain throughput, increases heat transfer, reduces metal loss, and cuts down time for maintenance.

A filming amine inhibitor, Polyrad forms a protective molecular film that safeguards refinery equipment from hydrogen-ion attack by organic and inorganic acids. Developed through Hercules research, Polyrad was specifically designed to control corrosion at low pH and it is highly effective over the entire pH range encountered in refinery operations.

Polyrad is quickly available from stocks located strategically throughout the nation. One of our technical representatives will be glad to work with you in evaluating Polyrad under your operating conditions. For additional data, write Hercules.



A PLUS FEATURE of Polyrad through the refinery is its detergent action which loosens iron sulfide and other scales so that they can be removed in the fluid stream.



CUTS DOWNTIME — By helping to maintain throughput and reducing metal loss, Polyrad keeps down time for maintenance to a minimum any place in the refinery where acidic corrosion or fouling is a problem.

POLYRAD PROTECTS many types of refinery equipment from hydrogen-ion attack. It is useful in condensers, distillation columns, re-boilers, and heat exchangers.

Naval Stores Department

HERCULES POWDER COMPANY

INCORPORATED

984 King St., Wilmington 99, Del.

POLYRAD®

FILMING AMINE INHIBITOR

NA54-6

CHEMICAL PROCESS NEWS

PUBLISHED BY CHEMICAL PROCESS DIVISION, THE M. W. KELLOGG COMPANY — OCTOBER 1954

NOTES ON PHENOL-FROM-CUMENE

Cumene, a war-time antiknock component for aviation gasoline for which Kellogg originated a manufacturing process and built a number of plants, is again in the news. Currently the company is building a plant, after having developed the mechanical design in which cumene will be produced and then used as an intermediate for manufacturing phenol in the Hercules-Distillers phenol-from-cumene process.

* * *

In this process, cumene is first oxidized to form cumene hydroperoxide. The latter is then split in a cleavage reaction into phenol and acetone, the two major products. The reaction also produces a small amount of methyl styrene.

* * *

The over-all process is an excellent example of how certain refinery products can be upgraded to industrial chemicals with a concomitant radical increase in value.

* * *

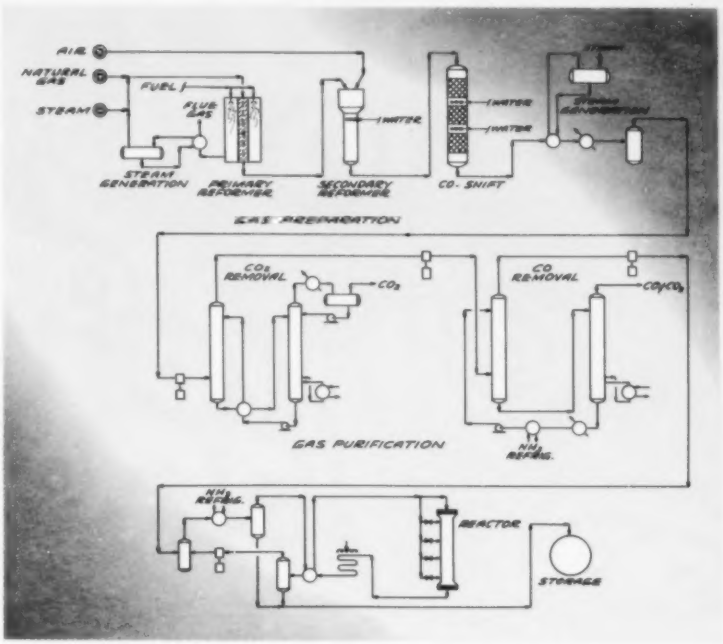
For example, propylene—a refinery by-product available at relatively low cost—makes up a third of the original feedstock volume when it is combined with benzene by alkylation to form cumene. After oxidation and cleavage, phenol is obtained from the benzene part of the initial input, and the low-cost propylene third of the input yields a substantial amount of acetone.

* * *

Thus, at present prices, acetone can be regarded as an attractive bonus for the producer—over and above the phenol produced as the major product. Moreover, the small quantity of methyl styrene made in the process can either be reconverted to cumene and used again or it can be sold to consumers in the plastics industry.

* * *

In addition to these favorable economic aspects, the process features low initial investment and operating expense. High pressures and temperatures are not used, and the consumption of chemicals such as alkalis and acids is comparatively low.



Unusually Low Investment Cost for Large, New Plant to Produce Ammonia

Kellogg has just been awarded the contract for a large ammonia plant which will make this basic fertilizer ingredient at the unusually low investment cost of approximately $50 per ton of annual capacity.

The plant, scheduled for completion in mid-1955, will be erected near Lima, Ohio, for The Standard Oil Company (Ohio). It will produce 300 tons of ammonia daily.

The major reason for the reduction in investment lies in the fact that the process employs only one ammonia synthesis section. Furthermore, operating experience with Kellogg ammonia converters has shown that they can be substantially reduced in size as can the heat exchangers without lowering capacity.

From the standpoint of operating costs, the new plant will have electrically-driven centrifugal compressors with concomitant savings in cooling water per-ton-of-ammonia produced.

As may be seen from the flow sheet, the plant will charge natural gas to a reformer where about 70% of the feed is converted into raw synthesis gas. This mixture is then fed to a secondary reformer where nitrogen in the form of air is introduced into the stream. Heat of combustion supplies the energy necessary to reform the remainder of the natural gas and to elevate the temperature to 1700°F.

As the mixture leaves this reformer, it immediately enters a quench vessel where its temperature is lowered by direct water quench. This not only brings the temperature down to the required shift reactor temperature but also provides the steam for the shift reaction.

From this point the mixture is fed to a gas purification section, the first step in which is a shift reaction. This converts the CO in the stream to CO_2, simultaneously producing H_2 as a result of the reaction with water in the form of steam.

Carbon dioxide removal, employing a regenerative MEA system, follows this step. This method of removing CO_2 has five advantages: no oxygen contamination, negligible synthesis gas loss, essentially complete removal of CO_2, the production of CO_2 in a pure usable form, and compactness of equipment.

Following this purification operation, traces of carbon monoxide left in the stream are removed. The synthesis gas is then passed through exchange and charged to the catalytic converters. The product gases from the converters are cooled in water coolers and then by exchange with

(continued on the following page)

ETHYLENE PROPYLENE BUTYLENE

METHANOL ETHANOL PROPANOL

BUTANOL ISO OCTYL ALCOHOL

BENZENE XYLENE TOLUENE

PHENOL FROM CUMENE

AMMONIA UREA

GLYCERIDES

(continued from previous page)

converter feed gas in the recycle gas exchangers. Anhydrous liquid ammonia is separated out in the primary separator and, after further cooling to 25°F in a refrigeration system, goes to an anhydrous ammonia product flash drum.

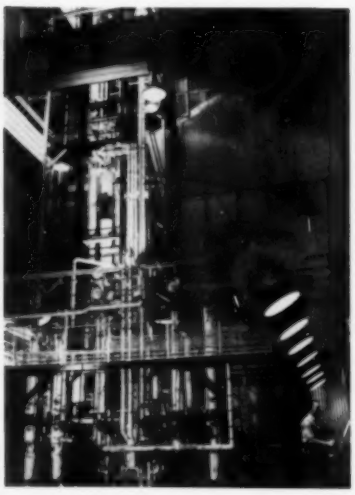
Six Solexol Plants in Six Years

In the six years since the process was first perfected in its laboratories, Kellogg has designed and built a total of six Solexol refining plants. The most recent one, a strategically important plant located in Norway, will among other things enable that country to double its production of glycerine.

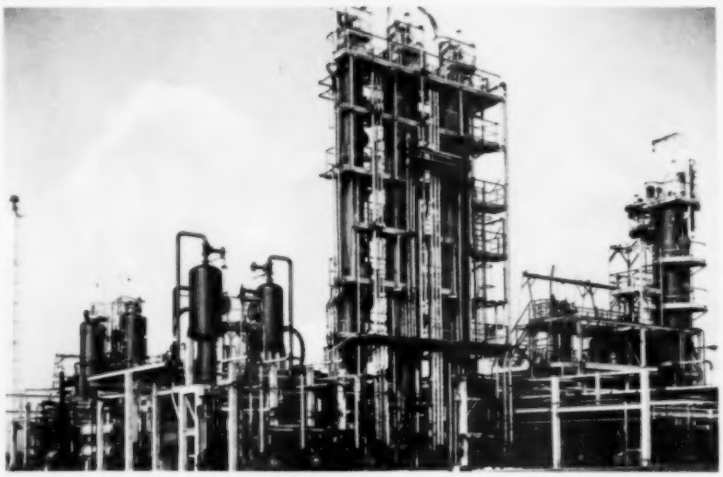
Solexol refining is a liquid-liquid extraction process—utilizing propane as the solvent—which has been applied primarily to extraction of vegetable and fish oils. The extraction is carried out at specified conditions of temperature, pressure and propane ratio in a continuous operation by counter-current contact of the oil and liquid propane in the fractionating towers.

At relatively low temperatures, liquid propane is miscible in essentially all proportions with glyceride oils. As the temperature is increased, progressively increasing amounts of an oil phase are precipitated, with different constituents of the various oils coming out of solution at different temperatures.

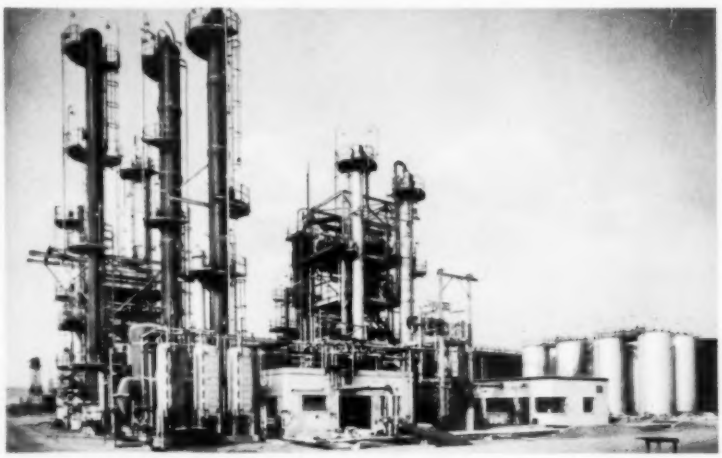
In the Solexol process, this property of propane forms the basis for the commercial separation of oils into their component parts. Separation is accomplished in the fractionating towers, while the remainder of the plant serves primarily to recover the propane from the oil fractions. Only small quantities of propane are required for make-up to maintain a constant inventory in the system.



Solexol pilot plant in Kellogg Petroleum and Chemical Research Laboratories.



Shown above is a typical Solexol plant. This one, located on the U. S. East Coast, is used for processing menhaden oil. The plant includes a propane destearinization unit for producing winterized oils.



The first phenol-from-cumene plant to employ the Hercules-Distillers process was this one located in Canada. (Details about the process may be found on the preceding page.)

For further information, technical data, etc., relating to chemical or petrochemical processing, write

CHEMICAL PROCESS DIVISION

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- ★ Polyethylene
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- ★ Anhydrous Ammonia
- ★ Methanol
- ★ Phthalic Anhydride
- ★ Liquid Fuel and Chemicals Synthesis from Coal
- ★ Glyceride Purification
- ★ Nitric Acid
- ★ Ammonium Nitrate
- ★ Ammonium Sulfate

60 cents buys how much of his time?

Let's assume your current piping maintenance labor rate, including burden, is $3.85. Less than 10 minutes is all you would get for 60 cents. Time to write a valve repair ticket and gather up tools—no more!

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It's safer . . . more economical . . . more sensible to stay with Crane quality. There's no better assurance of low-cost dependability on the job. That's why more Crane valves are in use than any other make.

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(To obtain more data on advertised products see page 1620)

How To Solve Corrosion Problems

PROBLEM: Protecting a preheater from corrosive attack during periodic contact with hydrochloric acid, trichlor benzene, and other chlorine compounds at 300 deg. F.

REMEDY: Complete lining with HASTELLOY alloy C 11-gage sheet.

RESULT: The vessel has given four years' service and is still going strong.

PROBLEM: Valving sulphur-laden flue gas at 800 deg. F. and 300 psi.

REMEDY: A ⅛-in. layer of HASTELLOY alloy B was applied to seats and seating surfaces.

RESULT: The valves gave over four years' service despite the corrosive conditions.

Free: Money-saving jobs like these are described in detail in the monthly magazine HAYNES ALLOYS DIGEST. To receive a copy regularly, write Editor, HAYNES ALLOYS DIGEST, Room 308, 30 East 42nd Street, New York 17, New York.

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PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY OCTOBER-NOVEMBER 1954

Interchangeable Bundles for Three Condenser Units

Three condensers recently completed in the Kellogg shops for a major refiner represent an optimum interchangeability of bundles—a feature every refiner wants but one that is often difficult to achieve in a unit without over-engineering it.

The three condenser units, designed to handle C-4 cuts, comprise a total of 14 shells. Following normal design practices, initial Kellogg engineering proposals included three sizes of shells. However, further study by Kellogg engineers proved, in this instance, that it would be most economical in the long run to design the entire group of 14 shells for interchangeable bundles. Both proposals were submitted, the customer agreeing that the interchangeable bundle plan best served their purposes.

Each of the 14 sections are of floating tube sheet construction with 2040 square feet of ¾-inch admiralty tubes, naval brass tube sheets, and steel baffles. Inside diameter of each shell is 33 inches.

Interchangeable bundles for this many sections will offer several important advantages to the refiner. They will, for example, cut down considerably on refinery maintenance stock, since only one spare bundle need be kept in stock to service any one of the 14 sections. Shorter down-time for repairs are also expected to result from the fact that the spare bundle can be substituted easily in an emergency without shutting the unit down for lengthy repairs or rebuilding.

For further information, details of methods, etc. contact

FABRICATED PRODUCTS DIVISION

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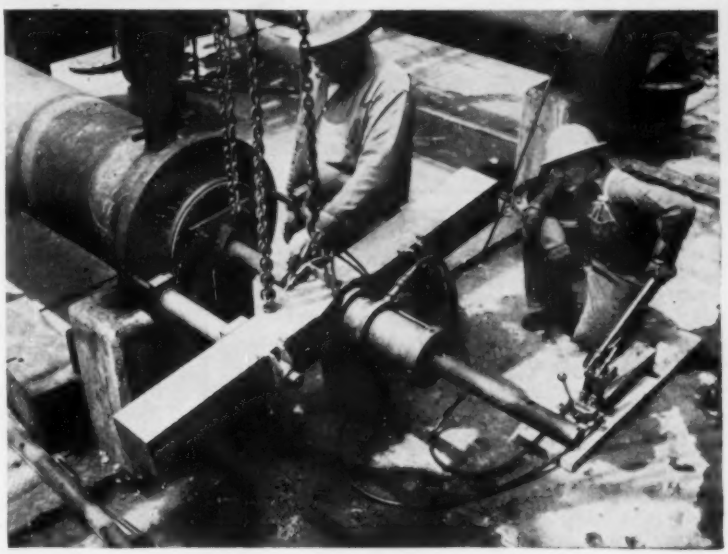


Portable Bundle Puller Saves Time Eliminates Costly Rigging

Shown here in use at a major Eastern refinery is Kellogg's special device, known as the Hydro-ejector, for removing and inserting heat exchanger bundles.

The device, portable and easily operated by two men, reduces down-time and eliminates the need for "jerry-built" rigging often required to pull even the smallest tube bundles. From the standpoint of time, experience has shown that it takes less than 25 minutes for the device to push a tube bundle out eight feet.

And even the largest bundles will not stick when pushed by the force of 12,000 pounds that may be exerted by the Hydro-ejector. The device is attached directly to the bonnet-end shell flange of the exchanger. It does not pull a bundle; it pushes it.

The Hydro-ejector is safer to use—particularly in the case of overhead exchangers—because workmen do not have to clamber out on the bundle after it is partly pulled to attach hoists. Ropes for lowering the bundle are attached as it is ejected and ride along with the unit from a trolley on the hoisting beam.

The Hydro-ejector will fit any size exchanger. Although now available for use in existing refineries, the unit was originally designed for customary types of exchangers in new processing plants as a means of reducing investment for supporting steel work. In cases where more than one Hydro-ejector is used, all parts including the jack and pumping unit are interchangeable. The only auxiliary equipment are two hoists, suspended at the channel end of the exchanger, to handle the tube bundle as it is ejected or replaced.

In operation, two men may work it with ease. One is required to pump the jack while the other keeps an eye on the bundle to ensure alignment.

Each unit consists of a hydraulic center-hole jack, supported by a fabricated steel base which is bolted directly to the exchanger. It is self-contained and portable, the heaviest piece of equipment being less than 75 pounds.

Send for New Booklet On Kellogg Exchangers

A new booklet which describes in detail the types of tubular heat transfer equipment available from Kellogg has just been completed. It not only shows examples of a variety of heat exchangers, coolers, condensers, reboilers and other process equipment, but also covers in some detail the expanded facilities available at Kellogg since the shops were modified for production-line manufacture of heat transfer units.

Field Test Shows: New gel-type ALCOA Activated Alumina improves dehydration of high-pressure natural gas

Results of the first 35 months of a full-scale field test on ALCOA's new H-151 Activated® Alumina gel indicate that the new desiccant has greater and more lasting adsorption power, has greater physical strength and is more resistant to particle breakdown in use.

After 20 months of operation, H-151 gel is capable of adsorbing 12.5 per cent water (to bring the gas to not over 7 lbs. water per M.M.s.c.f.), as compared to the figure of 7.5 per cent water on which most design calculations and specifications are based. Decrease in crushing strength over a 6-month period was only 18 per cent.

FIELD TEST

The field test was made at the Reddell separator station of Continental Oil Co., located 4 miles northwest of Reddell, La. This separator station receives natural gas (approximately 90 per cent methane by volume) from 17 wells in the area, with the average pressure at the well site being 2,400 psi. The normal flow from this field averaged 16 to 19 M.M.s.c.f. per day during the test period. Upon arrival at the separator station, the gas is expanded to approximately 850 psi. It then enters a number of separators where free water and distillate are removed.

The gas streams from the individual separators are combined and flow through a master separator where any additional liquid is removed. At this point the gas is free of any liquid, but is saturated with water and distillate vapors at the prevailing conditions of temperature and pressure. The gas stream then passes through the dehydration tower where the water is removed by the solid desiccant. The dried gas is metered and then recombined with the distillate for transmission to a gasoline plant.

DEHYDRATION TOWER

The dehydration tower used for the test is 16 ft. high and 3 ft. in diameter. Wet gas enters the tower at the bottom through a 4-in. pipe which extends above the top of the bed through the centerline of the tower. The gas is deflected downward through the bed by a bonnet at the top of this pipe. The dried gas leaves at the bottom of the tower.

REACTIVATION

Reactivation of the spent desiccant is accomplished by passing natural gas heated to approximately 360°F through the bed, countercurrent to the flow of the drying cycle. In normal operation, the towers at Reddell are switched every 8 hours. A tower is reactivated for 6 hours and cooled for 2 hours before being placed on the drying part of the cycle.

TEST PROCEDURE

The tower was charged with 3,900 lbs. of the new gel H-151 ALCOA Activated Alumina balls, ¼-in. to 6 mesh.

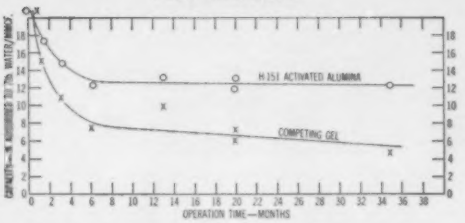
The first testing was carried out after the bed had completed several normal drying cycles. The tower was allowed to continue on stream without interruption until the water content of the effluent gas had gone above 7 lbs. per M.M.s.c.f. This quantity of water vapor is usually the standard allowable in the gas-transmission industry.

During a run, the water vapor contents of the inlet and the outlet gas from the dehydrator were determined at periodic intervals by standard methods. Gas flows were calculated from the readings on the orifice meter chart by a standard method.

Capacity test runs were made on the tower at seven different times. In addition to the data taken shortly after charging the towers, test runs were made after approximately 1, 3, 6, 13, 20 and 35 months of operation.

On two different occasions, once after 1 month's operation and again after 6 months' operation, the tower was opened and samples of the desiccant material removed from the top of the bed for screen analysis and determination of crushing strength.

TEST RESULTS



Performance record of Alcoa Activated Alumina H-151 and competing gel for 35-month period.

The typical run consisted of a fairly long period of constant effluent dew points which for all runs was below —20°F; a "break point" when the adsorption "front" reached the exit end of the bed; and then a period of constant rise in dew point. After 6 months of operation, the capacity of H-151 was 12.7 per cent, a much higher value than usually obtained with gel desiccant. After 20 months of operation, the capacity of the H-151 was still high, 12.5 per cent. After 35 months of operation, the calculated gas flow for H-151 was 10.39 M.M.s.c.f. over an 18-hour period. *Capacity was calculated to be 12.1 per cent* (7 pounds M.M.s.c.f. water content).

For the competing gel, however, the total gas flow was 4.66 M.M.s.c.f. over an 8.25 hour period. *Capacity was found to be 4.85 per cent.*

This higher-than-usual capacity for H-151 will enable existing units to run for longer cycles, with a corresponding decrease in reactivation cost, or at higher capacity, which will allow additional wells to be brought in. It will also allow the design of smaller-sized drying towers for new units on a particular job. Any of these, of course, represent real savings.

CRUSHING STRENGTH

The crushing strengths of the samples removed from the towers are also listed in Table 2. The test for this property consists of subjecting a weighted sample of 4-8 mesh material to a pressure of 1,000 psi. for 1 minute, and then measuring the amount of plus 8-mesh material remaining. The ratio of the weight of this fraction to the original weight is called crushing strength, and is expressed in per cent.

The new desiccant had an original crushing strength of 55 per cent, dropped to 45 per cent in 1 month and was still the same after 6 months. The per cent decrease in crushing strength was therefore approximately 18 per cent, much lower than ordinarily found in a gel desiccant.

TABLE 1—SORPTIVE CAPACITY DATA, NEW GEL

Date of test	Months of operation	Per cents Adsorbed* H-151
April 1951	0.1	18.8
May 1951	1.2	17.6
July 1951	3.3	14.9
October 1951	6.2	12.7
May 1952	13.0	12.8
December 1952	20.0	12.5
March 1954	35.2	12.1

*Per cent adsorbed to bring the gas to not over 7 lb. water per M.M.s.c.f.

TABLE 2—PARTICLE BREAKDOWN AND CRUSHING STRENGTH OF SAMPLES REMOVED FROM TOWERS

Mesh size	As Charged per cent	After 1 month's Service per cent	After 6 months' Service per cent
+4 mesh	82.0	84.9	70.8
4-8 mesh	17.9	14.3	24.8
8-14 mesh	0.03	0.76	4.3
14-20 mesh	0.01	0.02	0.1
20-28 mesh	0.01	0.01	0.01
28-42 mesh	0.01	0.01	0.0
-42 mesh	0.01	0.03	0.04
Total	99.97	100.03	100.05
Crushing strength, per cent	55.1	45.0	45.2

BED INSPECTION

The tower was blown down and opened for sample removal at the end of 1 month and again at 6 months. A visual examination of the material in the top of the bed showed that the balls had suffered little or no breakage. This fact is borne out in the screen analyses of these samples, along with that of the material as charged, which appear in Table 2.

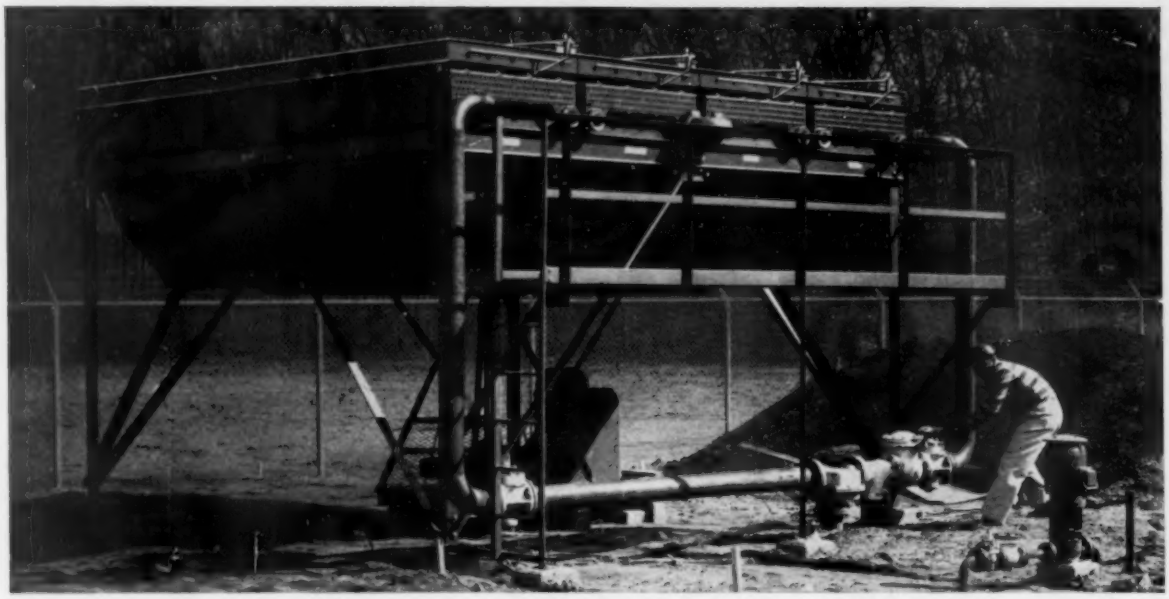
PARTICLE BREAKDOWN

At the end of 6 months' operation, over 95 per cent of the gel was still larger than 8 mesh. This lack of particle breakage is important because pressure drop through the bed is kept at about 10 psi.

For further information and samples of this remarkable new ALCOA Activated Alumina, write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 716-K Alcoa Building, Pittsburgh 19, Pa.

ALCOA CHEMICALS

ALUMINUM COMPANY OF AMERICA



Keep power consumption to a minimum with TRANE Fluid Coolers equipped with two-speed motor and heavy-duty automatic shutters over coil. This GC Series vertical discharge model comes in 8 sizes—fan dia. from 60″ to 216″.

New Trane fluid coolers reduce cooling costs!

Automatic shutters, two-speed fan motor cut operating hp to 35% of design hp. Hold to ±2°F. of desired leaving temperature.

Here's how to cut continuous-duty cooling costs to the bone with efficient TRANE Fluid Coolers. Units have two-speed motor . . . optional automatic shutters . . . blow-through design . . . minimum pressure drop on air side of coil . . . high heat transfer efficiency.

Cut power costs as much as 65%! Two-speed motor and shutters over coil operate automatically . . . together . . . to modulate capacity. Fluid Cooler motor operates at full speed an average of 20% of the time . . . at half speed 80% of the time. When motor runs at half speed, fan hp requirement is only ⅛th that at full speed . . . reduces power costs as much as 65%.

Leaving fluid temperatures held to plus or minus 2°F.—insures maximum operating efficiency from engine or process fluid being cooled.

Blow-through design can reduce power consumption 10%. Fans operate more efficiently because they always handle cooler ambient air.

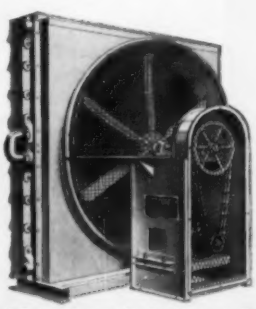
Shutters shipped installed on coil. Heavy-duty TRANE shutters are linked together to operate in unison. Counterbalanced blades have edges formed to interlock for tight shut-off. Full length shutter shafts turn in heavy bronze bearings . . . power is applied equally to both ends of shaft for positive uniform operation.

Protection against freeze-up. With shutters closed, convectional air circulation through coil is halted . . . a major safety feature not found in other designs.

Lower maintenance costs. Shutter controls are simple—rugged—in contrast to complex mechanism needed for variable pitch units. Result: more dependable performance, less downtime.

For full information, call your TRANE Sales Office or write TRANE, La Crosse, Wis., Bulletin DS-395.

Heavy-duty 14 ga. shutters do not warp or twist. Rugged framework of unit resists wind and earth shock.



Model EC horizontal discharge TRANE Fluid Cooler available in 14 sizes; fan dia. from 18″ to 90″. Shutters optional.

TRANE fluid coolers

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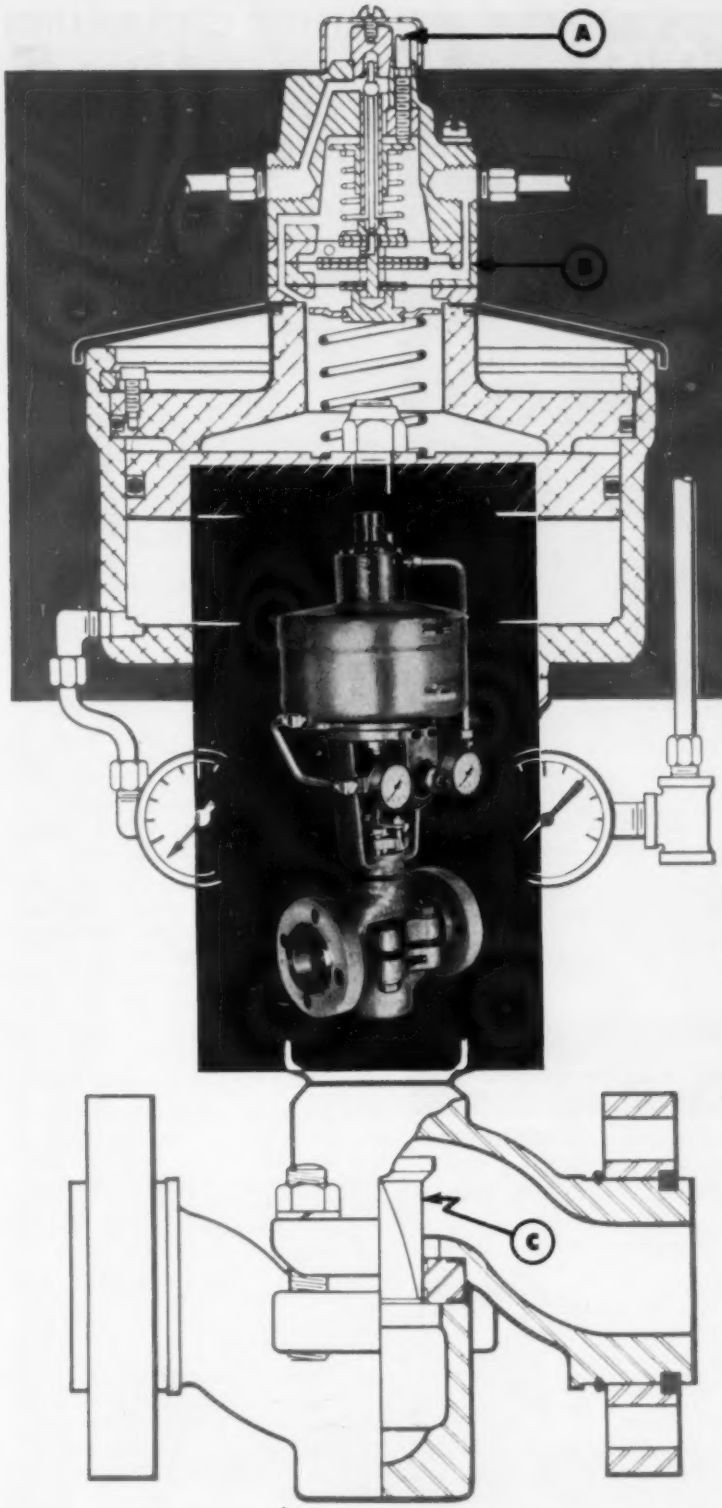
(To obtain more data on advertised products see page 1620)



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B—Direct & Reverse Acting Positioner

C—Precision-Cast Conoplug

Ingenious pneumatic piping arrangement and exclusive positioner design, permits opening or closing of valve on air failure with either direct or reverse action Conoplug.

Most control engineers agree on the advantages of *single-seated* valves for today's demanding process applications. But in order to successfully operate single-seated valves it is necessary to have better than average topworks . . .

Hence, the revolutionary CYLINDER CONOMOTOR. . . . 10 to 20 times more POWER than conventional spring motors . . . SPEED of response 5 to 10 times faster than diaphragm motors . . . 50% reduction in WEIGHT per unit of delivered power . . . 30% reduction in SPACE requirements . . . STABILITY and positioning ACCURACY unmatched by conventional spring-and-diaphragm or springless diaphragm motors.

The combination of the Cylinder Conomotor with the unique single-seated split body gives industry, for the first time, a fully coordinated valve design. Conomotor Series LB Control Valves meet *all* of industry's rigorous requirements.

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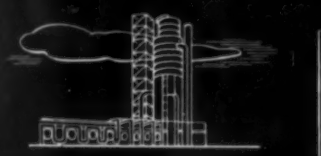
 (To obtain more data on advertised products see page 1620)

IS LIQUID CARRY OVER–

. . . Limiting Your Production?
. . . Affecting Product Purity?
. . . Cutting Into Your Profits?

IF SO–GET THE FACTS ON METEX MIST ELIMINATORS!



Section of a METEX MIST ELIMINATOR, opened to show construction. They can be made of practically any metal, to combat corrosion. Factory cut to fit vessel dimensions and contour, there is no limit to the size in which they can be obtained.

Liquid entrainment need no longer be considered an unavoidable nuisance in processing operations, as more and more engineers are finding from experience. These *knitted* wire mesh entrainment separators literally "filter out" the entrainment (see diagram) and permit the gas to pass on, freed from the unwanted–and often contaminating–liquid.

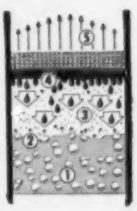
METEX MIST ELIMINATORS can be easily installed in new or existing vessels. They require no special housings, equipment or power–and need no servicing or attention. They function over a wide range of velocities with a pressure drop usually so low it cannot be measured. Users report efficiencies of 99% and more.

METEX Mist Eliminators can be used wherever the problem of liquid entrainment exists. By effecting complete removal of liquids, Mist Eliminators contribute to more efficient and economical processing in such vessels as:

- VACUUM PIPE STILLS
- FRACTIONATING TOWERS
- KNOCK-OUT DRUMS
- EVAPORATORS
- ABSORBERS
- SCRUBBERS
- COMPRESSORS
- SEPARATORS
- STEAM DRUMS

Write TODAY for free catalog giving complete information and engineering data. Or tell us about your SPECIFIC *entrainment problem.* ←

When a gas is generated in or passes through a liquid (1), it carries with it on leaving the surface (2), droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3). As the gas continually changes direction in passing through the pad, the droplets are impinged on the extensive wire surface. Here the droplets coalesce, forming large drops of liquid which break away (4) from the pad and fall back through the gas stream. The gas (5) passes on, freed from liquid entrainment.



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METEX

Roselle, New Jersey

CATALYST CONTAMINATION CURED BY REMOVING ENTRAINMENT IN DISTILLATION UNIT

Equipment Costing $15,000 Pays Out In Under A Week For Large Southwestern Refinery

It was not a difficult problem to trace the cause of mounting catalyst losses to a cat unit feed so poor in color that it was essentially black. Entrainment of liquid from the bottom of the still column could be the only answer.

Here was a situation where a Metex Mist Eliminator would remove the entrainment – but what else might happen? Would this knitted wire mesh separator cause excessive pressure drop? How quickly would it become plugged by coke deposits and make the column inoperable?

Calculations by one engineer showed that the total cost of installing a 25-ft diameter Mist Eliminator, including designing and erecting supports within the still, was approximately $15.000 – less than a week's catalyst loss. After considerable study the decision was made, and the Mist Eliminator installed during the next routine turnaround.

When the first run of cat unit feed came from the remodeled crude distillation unit, it was crystal clear and water white. Throughout the normal run no differential pressure across the screen was found.

The problem was solved. Catalyst losses dropped sharply. And the Mist Eliminator has paid for itself in a matter of days.

Have you really analyzed your entrainment costs, and checked the savings a Mist Eliminator could make for you? Perhaps you are losing valuable end products in the exhaust stream. Perhaps you have a nuisance contamination problem. Perhaps the entrainment created in one vessel is causing trouble in a subsequent operation. For entrainment is an inevitable result of most processing and refining operations.

Metex Mist Eliminators perform just one function–and they are doing it in more and more refining vessels every day. They remove liquid entrainment–efficiently and economically–wherever it may occur.

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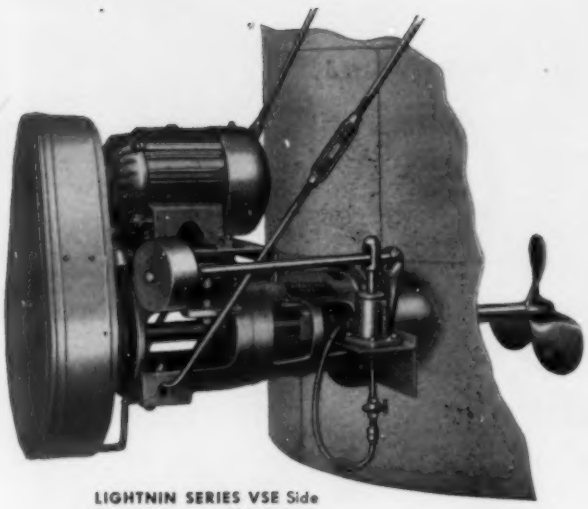

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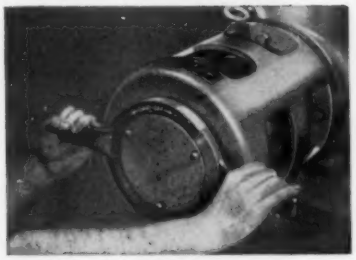

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PETROLEUM PROCESSING
OCTOBER 1954

The Cost of Fighting Smog . . .

RESEARCH

Company Research	$ 494,000
Outside Research	1,867,000
	$2,361,000

EQUIPMENT

SO_2 Corrective Equipment . . .	$ 6,338,000
Hydrocarbon Vapor Control . .	5,050,000
Other Refinery Emissions	11,528,000
	$22,916,000

It's expensive—according to Los Angeles refiners

By CHARLES POLLAK
West Coast Editor

THE fight against smog will have cost the petroleum industry in Los Angeles more than $25,000,000 by next May.

Such is the gist of information gathered by PETROLEUM PROCESSING from the eight largest refiners in Los Angeles County, representing an overwhelming preponderance of the county's refinery capacity.

The exact figure of $25,277,000 is given as of May 1, 1955. That is the deadline for compliance by the industry with a county rule requiring vapor control measures for gasoline and cracked stock storage tanks of 952 bbl. or greater capacity.

Of this sum, $21,493,000 had been spent through 1953 for research, sulfur dioxide control, hydrocarbon vapor control and for reduction and abatement of other refinery and terminal emissions to the atmosphere. The remaining $3,784,000 is being spent for the same purposes during 1954 and early 1955 as the last group of uncontrolled tanks is equipped with floating roofs or connected to vapor recovery systems.

The survey was in the form of a questionnaire, with the questions grouped under four main topics:

A—Research Expenditures
B—SO_2 Corrective Equipment
C—Hydrocarbon Vapor Control
D—Other Refinery Emissions

Here are the questions we asked **(in bold face type)**, the collective answers from the eight companies (*in italics type*), and additional facts and comments which we have added (in regular type):

A—Research Expenditures

The eight companies expended or are expending $1.07 on research for every $10 being spent for equipment. Hence, the survey's first question dealt with the cost of research carried on by company

We Made a Survey

PETROLEUM PROCESSING recently surveyed refiners in the Los Angeles basin to determine the cost to date of the petroleum industry's smog abatement effort. The survey was undertaken in full recognition of the fact that the intangible, immeasurable cost of the public ill will stemming from the industry's unwilling role as a scapegoat for smog ultimately will exceed by far the dollars-and-cents outlay for air pollution control equipment.

Nevertheless, the importance of the latter price tag cannot be underestimated, particularly by oil companies in areas where a duplication of Los Angeles' smog experience already threatens. The replies to PETROLEUM PROCESSING's questions came from eight companies representing 91.3% of Los Angeles County's refinery capacity. To avoid singling out any one company, the answers from each of the eight firms have been lumped together. Individual company figures are given in a few instances, however, where the company has already released such information for publication.

—The Editor

laboratories or handed to outside groups financed by the industry.

1—How much did you spend in your own company research on smog in 1953, and prior to 1953? How much do you intend spending during 1954?

2—How much did you or will you contribute to such research by outside groups during these same periods—and to what organizations?

	Company Research	*Outside Research*
1953	*$ 90,000*	*$ 354,000*
Prior to 1953	*315,000*	*1,211,000*
1954	*89,000*	*302,000*
Totals	*$494,000*	*$1,867,000*

The above figures on outside research represent the total cost of such work done by the Stanford Research Institute, American Petroleum Institute, and the Southern California Air Pollution Foundation (SCAPF).

It is noteworthy that a portion of this sum has been channeled to the foundation, a non-profit civic group in which the industry plays a decidedly minor role. SCAPF is financed by *all* Los Angeles business and industry, including—but certainly not dominated by—companies held to be smog contributors. In addition, the foundation works closely with the laboratory of the county Air Pollution Control District and in this connection receives some public funds to aid in carrying out specific research projects.

Thus, the public is afforded the heartening spectacle of the petroleum industry, other industries, business and commerce, the universities and public agencies working together to solve a common problem.

SCAPF investigations announced so far include:

—a survey of oxidants in the Los Angeles atmosphere and their relationship to other airborne substances;

—an air tracer survey to show whether windpaths determine the movement of air contaminants;

—a nitrogen dioxide survey;

—a study of the relation of oxidants to plant damage;

—an analysis of automotive exhaust gases;

—an eye irritation survey;

—a study of the effects of aerosols on visibility;

B—SO_2 Corrective Equipment

1—What have you installed in the way of refinery facilities for minimizing the emission of sulfur dioxide to the atmosphere?

All refineries are equipped with H_2S removal facilities.

2—When and where were the facilities installed, and what capital investment did they require?

Facilities were installed at refineries in Los Angeles County as early as 1936. Most of the installations have been made since 1949. The total cost of these installations was $4,893,000.

3—What does it cost you—net, after credits for any by-products recovered—to operate these facilities annually?

Few companies keep segregated costs. In general, H_2S removal facilities are operated at a loss.

4—How effective have these facilities been in reducing SO_2 emissions? What quantities of SO_2 were you releasing prior to their installation, how much are you releasing today, and how do those figures compare with your crude run to stills?

	Crude Run—B/D	*SO_2 to Air—T/D*
Before H_2S facilities	*430,000*	*374*
After H_2S facilities	*552,000*	*140*

The Air Pollution Control District takes a more generous view of the petroleum industry's SO_2 abatement program. In a recent publication it credited oil refineries with collecting the equivalent of "more than 400 tons of sulfur dioxide daily . . ."

However, the district pointed out that more than 300 tons daily, mostly from the burning of fuel oil, still is emitted. It added: "With the tremendous population and industrial expansion now taking place, the amount of sulfur dioxide going into the atmosphere may increase considerably.

"Since control appears impractical so long as oil is burned, future control may have to rest in increasing the natural gas supply, zoning of future sources from an air pollution control standpoint, or a combination of both."

This thinking, if carried to the conclusion apparently envisioned by the district, might force the loss of fuel oil markets on the petroleum industry. Such a loss would enormously increase the cost of smog to Los Angeles refiners.

To continue with the questions on sulfur dioxide—

5—Do you plan any further installations of this nature and, if so, when, where, and at what expense?

All future construction will be designed to comply with SO_2 regulations. Current construction includes $1,445,000 for facilities to reduce SO_2 emissions.

Recent announcements of SO_2 installations include one from Standard of California on the occasion of the dedication of a 40,000 b/d catalytic cracking plant at its El Segundo refinery.

"An important segment of the project is a plant for the recovery of hydrogen sulfide as another phase of Standard's long-standing program of avoiding air pollution. The H_2S plant will convert trapped fumes into sulfuric acid," the company said.

The cost of this and other pollution control facilities is included in a $6,000,000 total which Standard said has been spent since 1926 for control purposes at El Segundo.

Richfield Oil Corp. told of expending $150,252 for new sulfur removal process connections alone when it started up $40,000,000 worth of expanded facilities at its Watson refinery this spring. Total air pollution control expenditures made in conjunction with the expansion came to $6,737,431.

C—Hydrocarbon Vapor Control

1—How many storage tanks for gasoline and cracked stocks do you have which are affected by the recent ruling requiring floating roofs (or vapor recovery systems) on such storage—and where are they located and what are their capacities?

There are 639 storage tanks located at the refineries or tank farms in Los Angeles County. The combined capacity of these tanks is 26,784,000 bbl.

2—What tankage did you have prior to the ruling which was already equipped with floating roofs (or vapor recovery systems)?

There were 421 tanks with a total capacity of 20,262,000 bbl.

3—What tankage has already been so equipped as a result of the ruling—and at what cost?

Since the effective date of the ruling, 143 tanks with a total capacity of 4,328,000 bbl. have been provided with a floating roof or connected to a vapor recovery system at a cost of $3,102,000.

Standard has disclosed that it has installed floating roofs on 127 tanks at El Segundo at a cost of $2,365,000. Also, Shell Oil Co. has said publicly that it will have spent $2,084,300 on floating roofs by the end of the year.

Other concerns, large and small, have made similar announcements from time to time. Several of the companies told of progress made in this

connection early this year when the first deadline under the ruling found a few concerns forced to ask for additional time. However, the district stated in August that all companies would be in total compliance well before the final deadline of May 1, 1955.

Some companies, such as Wilshire Oil Co., concentrated on vapor recovery systems. Wilshire spent $100,000 for a system serving 12 tanks with 636,000 bbl. capacity.

4—What is your program for so equipping the rest of the affected tankage—and how much is it going to cost?

The remaining 75 affected tanks, with a total capacity of 2,194,000 bbl., will be in compliance before the ruling deadline at an estimated cost of $1,948,000.

5—When the program is completed, what volume of hydrocarbon vapors do you calculate will be saved annually—and what do you figure their value will be?

When this ruling went into effect, 66% of the total number of tanks, or 75.6% of the total affected tank capacity, was automatically in compliance. The remaining tanks affected by the ruling had not been similarly provided as the physical properties of their contents or the frequency of their turnovers did not cause any appreciable hydrocarbon vapor loss.

The economics of control installations on these tanks is not attractive and therefore would not warrant any capital outlay based on value of recovered vapors. However, the oil industry has cooperated with the control district in regard to this ruling although many of the installations cannot be economically justified nor regarded as major contributors to air pollution.

These figures, of course, apply only to the eight firms whose answers to the PETROLEUM PROCESSING questionnaire are summarized here. When the regulation in question—the district's Rule 56—went into effect in May, 1953, the district said it applied to 495 tanks in the county which were then uncontrolled.

Those tanks were said to be responsible for 140 tons daily of contaminants. In contrast, Stanford Research Institute's January, 1954 report on *The Smog Problem in Los Angeles County* estimated the daily release of contaminants from automobiles and household incinerators at almost 1,600 tons.

Sixty-one other tanks with an estimated total capacity of 3,000,000 bbl. owned or leased by the armed services in the county also will be controlled. These tanks had gone uncontrolled because of their absentee ownership and because control measures depended upon congressional appropriation of funds.

D—Other Refinery Emissions

Are there any other measures which you are undertaking in connection with the smog problem?

Other expenditures for hydrocarbon vapor control, reduction of smoke and fumes and odor abatement have amounted to an estimated $11,528,000. Equipment for reduction of hydrocarbon emissions from skimming ponds, vacuum jets, pump glands, and loading operations have been undertaken in addition to those from storage tanks as covered by Rule 56.

Gordon P. Larson, district director, reported in August that all skimming ponds had been corrected or controls were under construction. "It can now be considered that losses from separators no longer constitute a serious problem," he stated.

As for loading operations, P. S. Magruder, chairman of the Western Oil and Gas Assn. smoke and fumes committee, said that some kind of vapor recovery system will be installed by May 1, 1955 on every gasoline loading rack in the county handling 20,000 gal. per day or more.

Magruder, who is executive vice president of General Petroleum Corp., emphasized that these installations will be entirely voluntary and are not required under existing regulations.

Hydrocarbon Sources

Stanford Research Institute's report last January, "The Smog Problem in Los Angeles County," was a summary of seven years' research commissioned by the Western Oil and Gas Assn. It spelled out the sources of atmospheric pollutants in such a way as to place them in a new perspective. The itemization of the nearly 1,500 tons of hydrocarbons emitted daily (of 3,100 tons daily of emissions from all sources) speaks for itself:

Source	Tons Daily of Hydrocarbons
Production	32
Refining	155
Marketing	37
Filling service station tanks	24
Filling automobile tanks	28
Evaporation from automobile tanks and carburetors	164
Automobile exhaust	1,016
Total	1,456

Thus, exhaust gases make up 81% of the total organic hydrocarbons emitted and nearly 95% of the active hydrocarbons. The report added that backyard incinerators emit 400 tons daily of organic materials not necessarily hydrocarbons.

It said ozone is probably the key to smog since Los Angeles has been discovered to have the world's highest concentration of this oxidant.

"This ozone may react in the air with harmless materials such as hydrocarbons to form troublesome compounds that are responsible for many of the undesirable effects of smog," the report concluded.

Shortly after the report was released, the Air Pollution Control District told the county Board of Supervisors that three district scientists had definitely identified automobile exhausts as a source of ozone. Unburned gasoline and nitrogen oxides emitted by exhausts create ozone in the presence of sunlight, they said.

Their findings were significant as the first flat assertion that ozone, which is believed to "trigger" chemical reactions in the air which cause smog's undesirable effects, is directly traceable to vehicle exhaust gases.

Consequently, renewed interest was manifested in the possibilities of controlling, purifying or minimizing exhaust contaminants. These are being examined by the APCD, the SCAPF and a committee of the Automobile Manufacturers Assn.

The district has long been exposed to "anti-smog mufflers" presented by a number of inventors.

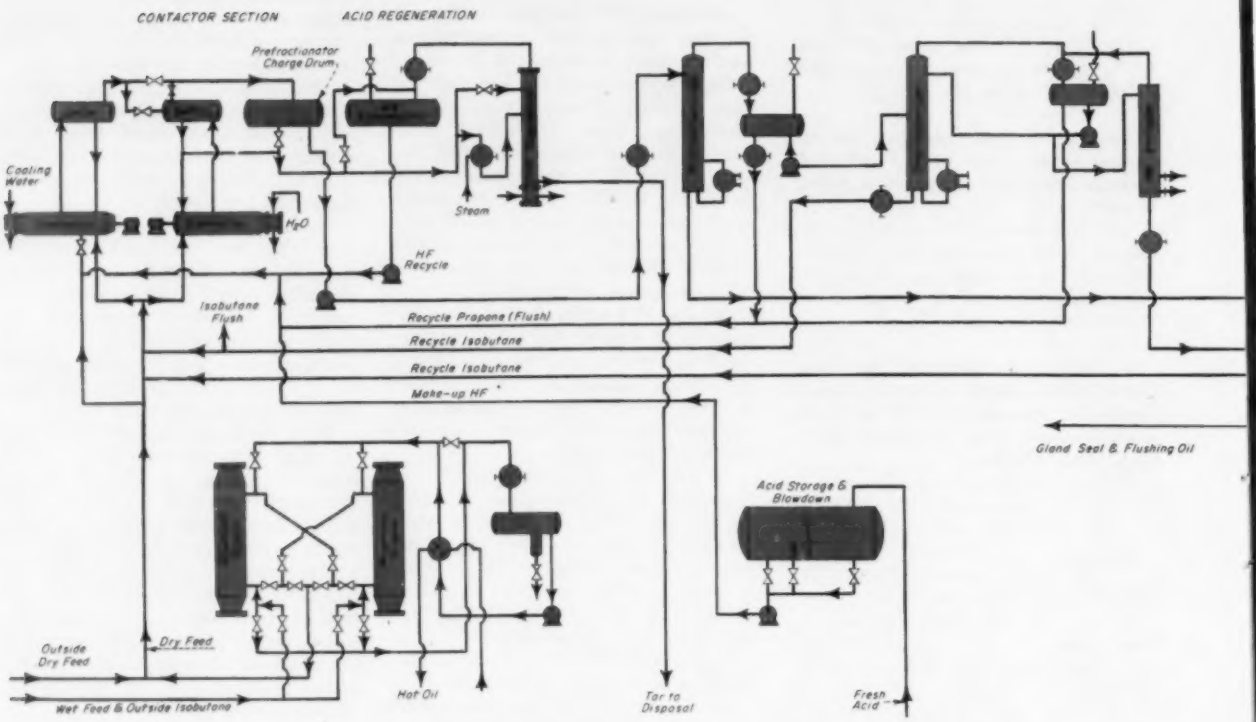
However, its optimism that such a device would be successfully developed has not been shared by the automotive group. J. M. Campbell of General Motors Corp., chairman of AMA's vehicle combustion products subcommittee, told a Society of Automotive Engineers meeting in August that exhaust-treating devices did not seem to be the answer.

"In order to be commercially practicable, such a device must operate without attention over a long period of time. It must be capable of functioning over a wide range of gas flow rates and compositions as found in the automobile exhaust. Catalytic devices must be unaffected by compounds of lead, sulfur, phosphorous and other elements normally present in gasoline and lubricating oil.

"At the present time we do not know of any device, regardless of price, that meets all of these specifications . . ."

Campbell said he thought the solution would come through improved combustion in engines.

Three Unusual Features in



By D. P. THORNTON, Jr.
Southwestern Editor

THREE unusual features serve to make the new hydrofluoric acid alkylation unit of Cosden Petroleum Corp. at Big Spring, Texas, an interesting subject for study. The new unit, which produces about 1800 b/d of aviation alkylate, went on stream this past summer—and is the backbone of Cosden's facilities for producing Grade 115/145 avgas for the Armed Forces. The unusual features are:

1—Feed stock consists of a mixture of olefins—propylene, butylenes and amylenes—rather than the high-purity butylenes stream ordinarily used. These mixed olefins are alkylated to produce high-quality aviation alkylate.

2—The unit is the first to use a horizontal contactor in HF alkylation. This modification is less expensive to install than the conventional vertical contactor and is expected to reduce operating costs. Provision also has been made to permit a considerable increase in throughput, should the future indicate this as desirable, without major changes in the existing unit—especially without adding more contactor capacity.

3—Only the net product streams from the unit—propane, normal butane, and alkylate—are defluorinated. Iso-butane recycle is returned to the contactors undefluorinated. Acid consumption is thereby minimized and is expected to run about 0.25 lbs. per barrel of light alkylate.

1 Mixture of Olefins Used For Feed Stock

Alkylate made from mixed C_3 through C_5 olefins and i-butane ordinarily is considered inferior in quality to that made with essentially pure C_4 olefins, due to the fact that a lower proportion of iso-octanes are produced along with a correspondingly higher content of lower-octane C_7's and C_9's. Moreover, the yield of "light" alkylate for aviation gasoline production generally takes a beating because the cut-point must be controlled to secure a satisfactory distillation by excluding some of the higher-boiling C_9's.

Cosden's olefinic feed stream at present consists typically of the following components:

propylene	15.63 vol.-%
propane	8.58 vol.-%
isobutane	32.56 vol.-%
butylene	27.90 vol.-%
n-butane	12.87 vol.-%
isopentane	2.46 vol.-%

In later operations the amount of isopentane and amylene will be increased to the maximum allowed by light alkylate quality and the efficiency of separation at the cat cracker stabilizer.

Outside isobutane for alkylation is a commercial product of 95% minimum purity, purchased from nearby natural gasoline plants. The volume charged to alkylation is based on actual isobutane content.

The quality of light alkylate produced is shown in the first column of Table 1. Note that the "perform-

New HF Alkylation Unit

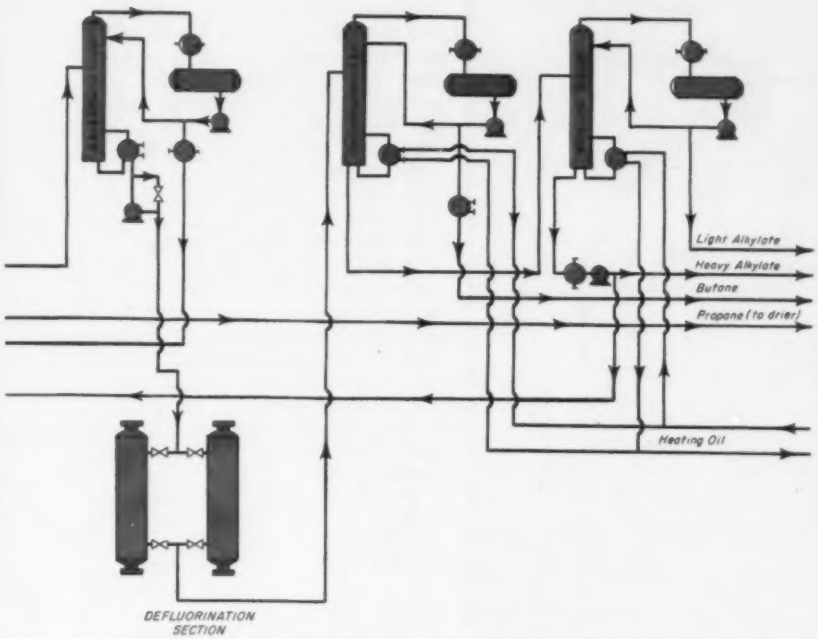


FIG. 1—Process flow diagram of Cosden's new HF alkylation unit

1 *Mixture of olefins used for feed stock*

2 *Horizontal contactor is first in HF use*

3 *Only net product streams are defluorinated*

ance numbers" when leaded with 4.6 ml. TEL are quite high and, in fact, are almost good enough to meet Grade 115/145 specifications without the addition of toluene for rich-mixture performance. Except for the drop in initial point resulting from the addition of isopentane for vapor-pressure requirements, the two specification avgas blends made from this alkylate are almost within limits of operator error in the ASTM distillation and but very little better than the alkylate in performance rating. The two blend samples were taken from separate storage tanks just prior to shipment and are considered representative of routine operations.

The alkylation plant, for which a $3,115,000 certificate was granted, was designed to produce 1860 BPCD of aviation alkylate, 98 BPCD of motor (heavy) alkylate and incidental propane and butane. The design charge was about 2200 BPCD of refinery olefins and 1000 BPCD of "outside" isobutane. Aviation gasoline production then was estimated at 2395 BPCD of Grade 115/145; Grade 115/130 will not be made. The unit was designed by Universal Oil Products Co., built by The Refinery Engineering Co. and went on-stream early last July.

Avgas production at present is about 2150 BPSD, assuming the blending of 6 vol.-% nitration grade toluene and 10% isopentane with approximately 1800 bbls. of light alkylate. Mixed xylenes if high purity also are available for blending.

Design of the HF unit is for the most part conventional, as indicated in the schematic flowsheet, Fig. 1. This flowsheet does not show the feed preparation section, which was modified from the former catalytic polymerization unit, nor the propane drying section, which also was a part of the cat-poly unit. Because the plant does not have facilities for separating olefins from the paraffins or segregating a B-B cut, but originally charged all these stocks to polymerization, is one of the two principal reasons why the alkylation unit was designed for a mixed olefin feed. The other reason was to produce the maximum amount of aviation gasoline with feed stocks available at the Big Spring refinery.

2 Horizontal Contactor Is First in HF Use

The horizontal contactors are the principal equipment innovation in this unit. Designed by the Stratford Engineering Corp., they are modifications of that company's vertical war-time units which were installed in most of the early HF alkylation plants. The horizontal vessels have several advantages over the vertical design. Structural steel requirements were greatly reduced by eliminating vertical extraction of the tube bundles, and foundations were simplified.

A second improvement is the elimination of the right angle gear which was necessary when driving a vertical shaft with a horizontal driver. Alignment and maintenance problems of the drive mechanism have thus been reduced, and the new units are not so noisy as the vertical ones usually were.

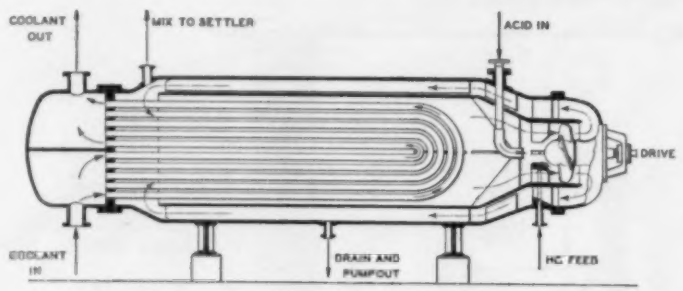


FIG. 2—Horizontal contactor details. All previous contactors in HF units were installed vertically; this is the first horizontal installation

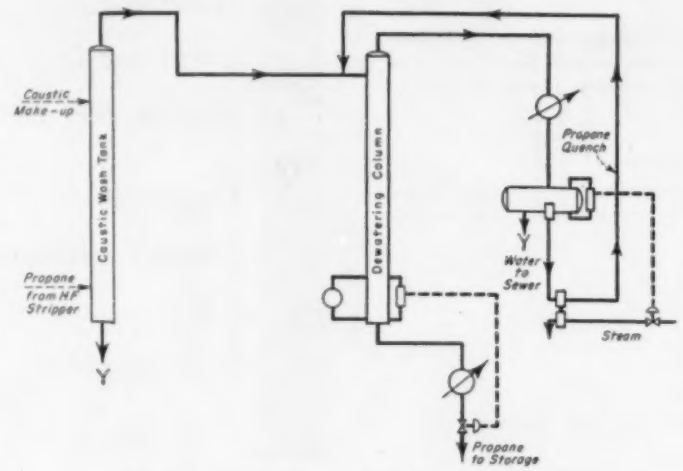


FIG. 3—Propane dewatering and final treating system

Table 1—Inspection of Light Alkylate and Final Avgas Blends in Routine Operations

	Light Alkylate	Grade Avgas	115/145 Blends**
Gravity, °API	73.2	70.8	69.4
Vapor Pressure, Reid, lbs.	4.3	6.8	6.6
ASTM Distillation, °F.:			
IBP	128	102	108
10%	166	144	144
20%	182	164	160
30%	194	176	175
50%	207	200	200
70%	216	213	213
90%	230	228	224
EP	304	300	290
Recovery, %	98.0	98.5	98.0
Residue, %	...	0.5	0.5
Gum, mg./100 ml.:			
Accelerated, 16 hrs.	...	1.4	1.3
Existent	...	0.4	0.3
Doctor Test	sour	neg.	neg.
Corrosion	...	pass	pass
Performance Rating:			
F-3 Method, 4.6 ml. TEL	122-123*	120.0	120.0
F-4 Method, 4.6 ml. TEL	140-141*	145.6	145.2

*Typical range.
**Light alkylate, 84 vol.-%; nitration grade toluene, 6%; and iso-pentane (95% minimum purity), 10%.

Moreover, the horizontal contactors require less horsepower than the vertical ones, and the impellers are designed for speed available in 60 cycle motors, making direct connection possible.

Since the impeller shaft also is horizontal, there is less load on the thrust bearing, which in the vertical design had to support the dead weight of the shaft and impeller as well as dynamic load. In the horizontal unit the space around the inner mechanical seal is self-draining into the contactor, so that there is no possibility of pipe scale or water collecting at this point—as was unavoidable in the vertical design. Piping is simplified and valves are accessible from ground level positions.

A sketch of the horizontal contactor is shown in Fig. 2. The two contactor vessels for the Cosden plant are 5 ft. in diameter by 22 ft. long, hold 87 bbls. of liquid and contain 492 U-tubes in the cooling section. The impeller circulates the contents at the rate of approximately 8000 gpm., and is driven by a 1160 rpm., 50 Hp. motor.

There are two sets of mechanical seals as in the vertical design, but this is the only similarity. The horizontal unit uses a ball-type shaft bearing instead of the sleeve bearing of the old vertical unit; it is similarly located, between the seals. Outboard of the last seal is a thrust-bearing and the impeller shaft is direct-coupled to the driving motor.

Feed, consisting of the combined olefin charge, make-up and recycle isobutane, and part of the HF, enters the contactor near the impeller, inside the baffle encircling the cooling water tubes. Being on the suction side of the impeller, it is immediately drawn into the 8000 gpm. circulating stream and thoroughly mixed with the contents of the vessel. Similarly, the balance of the HF enters the vessel from the settler located immediately overhead and likewise is drawn into the impeller.

The emulsion leaves the impeller, makes a 180° turn, and travels to the other end of the vessel outside the baffle. At the other end of the vessel is the normal mix outlet, but the circulating steam then makes another 180° turn and is drawn back to the mixing impeller around the bundle of cooling tubes. The cooling bundle is of the bare tube type with hairpin tubes, fixed only at the sheet end.

The contactors now are operating within the range of 85 to 90° F. with cooling water entering at 77 and leaving at 80° F. A special cooling tower was installed to serve the contactors

and provide other cooling services at the unit. A 5° approach to wet-bulb was specified in its design.

An increase in capacity of the contactors, if it proves desirable later, can be achieved by refrigeration. This will not only provide for cooling, but will permit lowering average contact temperature. Refrigeration was considered in the original design of the unit but, under foreseeable operating requirements, the investment and operating costs favored installing a cooling tower with close approach to the wet-bulb, especially since additional cooling water capacity was required in any event over that available from the refinery's existing cooling water system. A propane refrigeration system probably will be used when and if lower contactor temperatures are desired.

3 Only Net Product Streams Are Defluorinated

Defluorination treatment of only the product streams reduces hydrofluoric acid consumption. The alumina (bauxite) defluorinators are located between the deisobutanizer and debutanizer, and therefore process only butane and total alkylate, in order to avoid handling the large flow represented by the isobutane recycle. By eliminating the recycle stream, which is approximately 11 times greater than the olefin input and contains some organic fluorides and traces of HF, the alumina towers were correspondingly sized smaller and require less frequent alumina replacement.

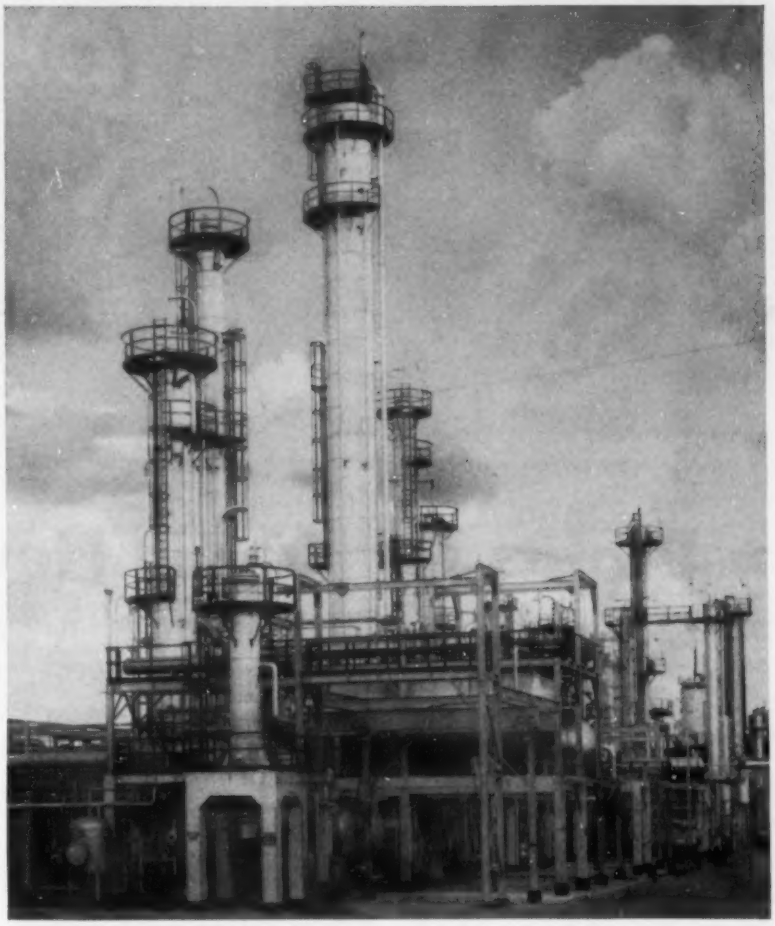
HF is removed from the propane in the HF stripper, the overhead from which returns the small amount of HF recovered in this manner to the depropanizer overhead accumulator. This stripper is worked hard enough to return an appreciable amount of propane, also. Depropanizer bottoms are returned as part of the isobutane recycle, since the prefractionator top temperatures are such as to carry over an appreciable amount of isobutane in order to completely remove propane from the deisobutanizer feed.

The acid regenerator has the dual job of removing heavy acid oils from the system as well as reconcentrating hydrofluoric acid by water removal. This column has a steam reboiler in the bottom to vaporize the HF overhead for condensation and recovery in the HF accumulator for return to the contactors. Part or all the feed may be preheated if desirable to have more heat in the column. The heavy oils and water are withdrawn from the bottom of the column to the tar disposal system.

The tar disposal system, not shown, consists of a scrubber kept about two-thirds filled with caustic. Acid-oil and acid-water, along with caustic make-up, are emulsified through a mixing jet and enter the vessel below the normal caustic level. Neutralized oils flow from the top to plant boiler fuel storage. Spent caustic is withdrawn from the bottom.

The volume of acid water disposed of in this manner amounts to about 1 b/d, containing only a small amount of HF, and thus is too minor to warrant recovering. Together with acid in the acid-oil, plus plant leaks and the like, the total consumption of HF is not expected to exceed 0.25 lbs. per bbl. of aviation alkylate produced. HF replacement would be considerably higher if defluorination were not restricted to unit effluent streams only.

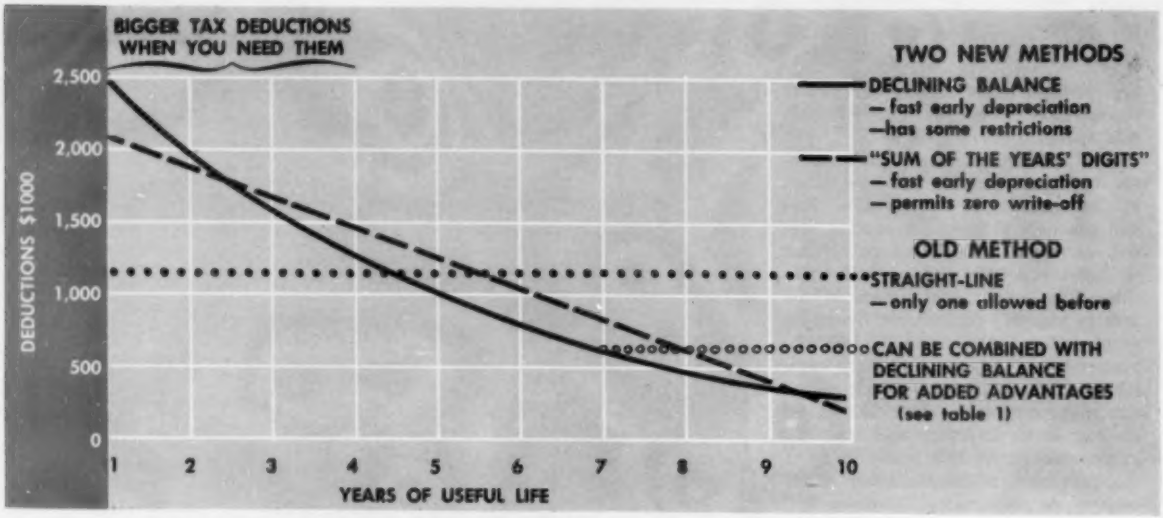
Hot oil is used as a heating medium in reboilers for the debutanizer and alkylate rerun columns, and in deethanizer and depropanizer in the feed preparation section, while steam is used to reboil the deisobutanizer.



GENERAL VIEW of Cosden alkylation unit. Three tall towers in immediate foreground are (L. to R.) prefractionator, depropanizer, deisobutanizer

Propane dewatering and treating are handled in the system shown in Fig. 3. Essentially, it consists of a small caustic wash tank which eliminates any traces of HF, and a dewatering column where the water is vaporized overhead along with whatever quantity of propane that comes with it. The water condenses out and settles in the accumulator, from which it is discarded to the sewer. Wet propane is withdrawn from the accumulator under level control and recycled to the dewatering column.

Relatively few "bugs" have arisen in placing this unit on-stream and there have been no accidents from leaks or spills of HF-contaminated streams. Part of the ease in start up is ascribed to the use of a graphic type panel, which helped to familiarize operators with the unit quickly. The operators also were trained in visits to other refineries having alkylation units.



HOW SEVERAL WRITE-OFF METHODS WORK under the new tax law on a $12,500,000 catalytic reforming unit with $700,000 salvage value and 10 years of life

Profits for You in New Tax Law

New write-off methods permit bigger deductions when you need them—during the earlier years

By WALLER GROGAN, C.P.A.
Louisville, Ky.

THE liberalization of the tax rules covering the deduction of expenditures for research, experimental, development and plant expansion projects represents good news for petroleum processors.

Under the old law, the rules regarding such costs were vague and uncertain. As a result, large concerns which carried on continuing research programs were generally able to deduct costs of this nature currently as incurred. On the other hand, new and smaller firms which carried on only an occasional project found that they were required to capitalize research costs until the project was either abandoned or resulted in a patent which could be written off over its useful life.

Frequently it was extremely difficult for these companies to prove that either one of the events had occurred, and in these cases it was impossible to secure any tax deductions whatsoever for research and development costs.

The new tax rule (in effect right now and applicable to years beginning after 1953) remedies this inequity by permitting the immediate deduction of research and development costs in the year in which expenditures are made, whether or not a patent is secured. The immediate write-off of such costs is elective with the taxpayer, so that those corporations which prefer to capitalize the costs of research and experimentation until a patent has been secured may still continue to do so. If the expenditures are capitalized, and if a patent is achieved, they will be deductible for tax purposes over the useful life of the patent.

Where it is impossible to determine what the useful life of a resulting patent might be, the research and experimental costs may be written off over a period chosen by the taxpayer, which may not be less than 60 months.

Speedier depreciation — Another strong incentive for expansion is found in the greatly liberalized depreciation rates which will now be allowed on new equipment purchases.

Formerly a catalytic reforming unit, with a cost of $12,500,000, an expected useful life of 10 years and a salvage value of $700,000, generally had to be depreciated in equal annual installments, in this case 10% per year, after salvage value had been subtracted from original cost.

But now the new declining-balance method, to name only one of several methods permitted, allows double the straight-line rate to be applied.

Under the declining-balance method, the rate is applied against the *undepreciated* cost rather than against the *original* cost, as in the old straight-line method.

However, under declining-balance alone, equipment could never be written down to zero, even where no salvage value was anticipated. Therefore, Congress granted permission for a change to the straight-line method at any time. Thus owners, after deducting the larger part of their investment over the first part of the useful life (usually half), can switch to straight-line and write off the remaining cost completely—*if* the asset is expected to have no salvage value.

Another method of depreciation now permitted also provides for speedier depreciation. This one, called the "sum of the years' digits" method —like the old straight-line method— requires the rate to be applied against

Study New Law Carefully

Only a few of the more than 3,000 technical changes in the revised tax code have been mentioned in this article, although the changes discussed are significant ones.

Taxpayers should study promptly the many specific provisions of the massive new law which may apply to their particular business. The revised code, with certain exceptions, takes effect as of January 1, 1954, and it therefore affects current as well as future decisions.

Table 1—Comparison of Write-off Methods

(As applied to reformer costing $12,500,000, with 10 years' life, salvage value, $700,000)

Year of Useful Life	Straight-Line 10%	Declining-Balance 20%	Declining-Balance for 7 yrs, then straight-line, 3 yrs	"Sum of the Years' Digits"	
1	$1,180,000.00	$2,500,000.00	$2,500,000.00	$2,145,454.50	(10/55)*
2	1,180,000.00	2,000,000.00	2,000,000.00	1,930,909.05	(9/55)
3	1,180,000.00	1,600,000.00	1,600,000.00	1,716,363.60	(8/55)
4	1,180,000.00	1,280,000.00	1,280,000.00	1,501,817.15	(7/55)
5	1,180,000.00	1,024,000.00	1,024,000.00	1,287,272.70	(6/55)
6	1,180,000.00	819,200.00	819,200.00	1,072,727.25	(5/55)
7	1,180,000.00	655,360.00	655,360.00	858,181.80	(4/55)
8	1,180,000.00	524,288.00	640,480.00**	643,636.35	(3/55)
9	1,180,000.00	419,430.40	640,480.00	429,090.90	(2/55)
10	1,180,000.00	235,544.32	640,480.00	214,545.45	(1/55)
Total depreciation	11,800,000.00	11,157,822.72	11,800,000.00	11,800,000.00	

* Fraction determined by formula prescribed for "sum of the years' digits" method.
** Straight-line rate for remaining years of useful life is applied to the remaining cost, less salvage value.

original cost, *less salvage value*, if any. But, unlike the result under declining-balance, a complete write-off to zero is possible.

The rate each year is expressed as a fraction determined by a prescribed formula. The denominator of the fraction is the "sum of the years' digits." The numerator the first year is the total years of life. It is reduced one each year, and so on down to one for the last year of life.

Table 1 shows how the methods compare when applied to the catalytic reforming unit referred to previously, costing $12,500,000 with a useful life of 10 years and a salvage value of $700,000. In the straight-line method, and also in the "sum of the years' digits" method, the salvage value is subtracted from the original cost before the rate is applied. In the declining-balance method, no subtraction is made.

In this example, after 10 years, the undepreciated balance of cost is $1,342,177.28. If the reforming unit is sold for the expected $700,000, a loss of $642,177.28 will be sustained and, of course, this loss can then be deducted. However, if a switch is made to the straight-line method when the annual deduction under declining-balance would be less than under straight-line, the balance of cost (less salvage) can be written off. In this example, that point comes with the 8th year of life.

The advantage of the declining balance method is this: 67.2% of cost will have been written off in 5 years. It allows almost twice as much deduction as the straight-line method in the first two years, the years when the effect of a large expenditure is most felt and when returns from use of the new equipment may not yet be fully realized.

Certain restrictions on the use of the new methods must be observed. They apply only to *new assets* acquired after 1953. They do not apply to purchases of used equipment or to older purchases. A refiner may, however, put in a new streamlined floor layout in his maintenance shops, or new ventilating equipment, as well as manufacturing equipment, and these can be depreciated under one of the new methods. Also, the declining-balance method applies *only* to assets whose estimated life is at least three years.

Record-keeping—It should also be pointed out that whenever a change is made from declining-balance to straight-line, the change must be made for all assets in a "record-keeping group." So, it may be necessary to keep asset records by year of acquisition, as well as by class, to insure the most benefit from the right to change.

Accumulation of Earnings — Another incentive to expansion lies in the liberalization of the new law with respect to retaining profits for the purpose of financing future modernization and expansion programs.

Under the old law there was a risk in accumulating earnings, since corporations had to prove they were for "reasonable needs." This term was not defined, and frequently plans for future expansion were not enough. There was always the possibility that any accumulation of earnings by a corporation might be considered a device, not for financing expansion or modernization, but for avoiding dividend payments to help stockholders reduce their personal income taxes. If any such retention could not be proved reasonable, a penalty tax was levied.

Under the new law a corporation with bona fide business reasons for accumulating earnings may feel freer in doing so. While the penalty tax is still in effect, the Internal Revenue Service must now undertake proof of the unreasonableness of an accumulation. Shifting of this burden of proof is significant.

Moreover a corporation will not even be exposed to the penalty under the new law unless it has retained earnings (from all years) beyond $60,000. Greater accumulations are permissible so long as there is reasonable *anticipation* of reinvesting for future requirements. And if there is unreasonable accumulation in any year, the penalty applies only to that part which is unreasonable.

Maintenance Contracts—All these liberalizing features of the new law taken together may well lead to a reappraisal on the part of refineries of the present policy of contracting for maintenance work. Repairs are always extensive, but now that investment is made easier, some refineries may find it more advantageous to install their own maintenance shops rather than to contract for such work.

Meet the Author

Waller Grogan, a partner in the firm of Escott, Grogan & Co., Certified Public Accountants, has engaged in tax practice for the past 14 years. He has appeared on the program at Tax Institutes at New York University, the University of West Virginia, and the University of Kentucky. Mr. Grogan is also a contributor to J. K. Lasser's "Handbook of Tax Techniques," and serves on the Committee on Federal Taxation of the American Institute of Accountants.

'Limiting Entering Head'—or—

How Much Can a Pump Pump?

LEH suggested as new term to define pump capacity, in place of NPSH

By R. A. MILLER
Application Engineer, Centrifugal Pump Section
Allis-Chalmers Mfg. Co., Milwaukee, Wisc.

WHILE a pump's physical size and rotative speed are obvious limitations, suction conditions often limit its capacity. Many users who have had difficulties with their installations have learned this limitation the hard way.

Common designation of the suction limitation of a pump's capacity is "net positive suction head above vapor pressure" or *NPSH*. This terminology can be confusing except for those dealing with pumps continually because the full definition is seldom used. The phrase "above vapor pressure" is frequently omitted, and *NPSH* is often mistaken for the so-called suction head.

The suction head (*SH*) is generally accepted to mean the gage reading on the suction side of the pump after it is primed but before starting up. The discharge head (*DH*) is the desired gage reading on the discharge side. Total head (*TH*) is the work produced, or discharge head plus or minus suction head.

NPSH is intended to mean the difference expressed in feet between the state of the liquid and the saturation or boiling point referred to the centerline of the pump. Since the suction head is certainly "net" and is often "positive," it is no wonder that young engineers and casual acquaintances with pumps have trouble understanding this limitation.

To simplify matters, why not call it "limiting entering head" (*LEH*)? This designation sets the concept apart from the suction head, it suggests a limitation, and it is shorter. The terms flashing, vaporizing, vapor binding, losing prime, sealing head, submergence, suction lift, etc., are all used in various instances to describe *NPSH* or the lack of it.

The writer feels that limiting entering head will simplify the explanation and understanding, and it is hoped reduce all of the above to one term—*LEH*.

A pump will lower the pressure at its inlet due to the pumping action. In other words, it sucks in the liquid. *LEH* is the measure used to determine how much the pump can lower the pressure at the pump inlet without vaporizing (flashing) the liquid.

We have all heard the expression "vapor lock" or "vapor binding." This condition results if the pumping action or suction lowers the pressure of the liquid beyond its boiling point.

Obviously, then, there are two *LEH* considerations:

1—How much will the pump reduce the pressure at the inlet?

2—How much external head is there available at the installation above the vapor pressure or boiling point?

No single formula or calculation can be set up for all pumps because speed of rotation, vane angle, entrance losses, and other factors of design will effect the result to a very marked degree. Therefore *NPSH* test results are tabulated and plotted against gpm on all pump curves. Then it is merely a matter of selecting a pump which will not reduce the pressure beyond the available or installation's *LEH* or *NPSH*.

The pump limitation is known as the required *LEH* or *NPSH*. The installation limitation is known as the available *LEH* or *NPSH*.

As an academic illustration which is theoretical only and is not to be used for actual calculation, the pump's required *LEH* can be set up as follows:

$$Q = AVK$$

where:

Q = Volume or gpm.
A = Inlet area of the pump.
V = Entering velocity of fluid.
K = Designer's or variable factor.

For a given size pump, the inlet area A is fixed. K also is a constant at a fixed rpm.

Then Q varies with V.

Since $V = 2gh$ and g is a constant (pull of gravity, 32.2), then Q varies with h; h is the head in feet required to produce the necessary velocity V and resulting volume Q to flow into the pump.

Conversely, if h is fixed it is the *LEH* because it is the only source of energy available to produce the necessary entering velocity. If the pump attempts to produce a greater negative head or suction, it will only succeed in lowering the pressure beyond the saturation or boiling point and the liquid will partially vaporize. Then no greater volume of liquid can enter the pump and the so-called break-off point is reached. If the pumping action is not curbed by throttling the discharge, vaporization (flashing) may be aggravated to the point where the pump fills with vapor, becomes vapor bound, and quits pumping entirely. The remedy then is to shut down, reprime the pump, start up again, and

R. A. Miller

Meet the Author

Rudolph A. Miller, an application engineer in the centrifugal pump section of Allis-Chalmers Manufacturing Co., Milwaukee, Wis., joined the firm's student co-operative course in 1927 while studying mechanical engineering at Marquette University. He received his engineering degree from Marquette in 1930.

Mr. Miller's career at Allis-Chalmers has embraced engineering work in the blower and condenser, steam turbine, and centrifugal pump sections, and he has been associated with the latter section since 1948. He is a licensed Wisconsin professional engineer.

maintain a partially closed discharge to prevent the same occurrence.

If the liquid being pumped is above the pump centerline, vents from the pump suction chamber led above the liquid level will maintain an automatic prime but will not prevent vaporization or flashing and perhaps a very noisy operation. Throttling the discharge or raising the liquid level are the only remedies, assuming, of course, that the suction piping is adequately sized and as short as possible.

It was stated previously that the required *LEH* of pumps is tabulated on pump curves plotted against gpm or volume *Q*. A pump whose required *LEH* is equal or preferably less than the available *LEH* of the installation site must be selected. Calculation of the available or installation *LEH* is relatively easy.

1—Determine H_E—the elevation in feet of the pump centerline above or below the minimum level of the liquid to be pumped. This value will be positive if the pump centerline is below the liquid level, or negative if it is above the liquid level.

2—Determine P_A — the absolute pressure above the surface of the liquid, expressed in feet of the liquid. (Pressure in psi. can be converted to feet of liquid by multiplying the psi. value by 2.31, and then dividing by the specific gravity of the liquid.)

3—Determine P_V — the internal vapor pressure of the liquid due to temperature, expressed in feet of the liquid.

4—Determine H_F—the friction of the suction piping system (pipe, fittings, valves, screens, etc.) in feet. Friction losses can usually be taken from tables provided by the manufacturers of the various items in the system.

The available or installation *LEH* can then be computed from the following formula:

$$LEH = (P_A - P_V) \pm H_E - H_F$$

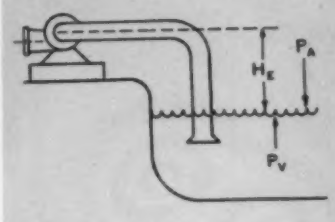
This formula determines the difference in pressure (in feet) between the state of the liquid and its boiling (vaporization or flashing) point measured at the pump centerline.

Don't be misled by a relatively high suction head. If the high suction head is due to steam pressure remember that the liquid is at the same temperature where P_A and P_V are equal and the only *LEH* available is the static elevation minus friction.

This situation is the one with which the person with only a casual acquaintance with pumps has the most difficulty. The suction head and *NPSH* are two widely different animals, hence the need for a new designation, *LEH*.

3 Examples of How to Calculate LEH

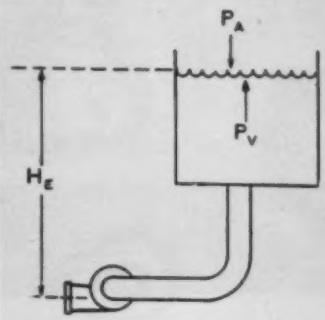
Pumping water from a river, lake or reservoir at approximately sea level



H_E = 10 ft., elevation of pump centerline above water level.
P_A = 34 ft., the absolute pressure above the surface of the water. (For all practical purposes, this value will be reduced 1 ft. for each 1000 ft. elevation above sea level.)
P_V = 0.6 ft., the internal vapor pressure of the water (at 60° F.).
H_F = 2 ft., pipe friction.

$$LEH = (P_A - P_V) \pm H_E - H_F$$
$$= (34 - 0.6) - 10 - 2$$
$$= 21.4 \text{ ft.}$$

Pumping water from an open tank, at an elevation of about 1000 ft. above sea level.



H_E = 12 ft., elevation of pump centerline below water level.
P_A = 33 ft., the absolute pressure at 1000 ft. elevation.
P_V = 11.2 ft., the internal vapor pressure of the water (at 160° F.).
H_F = 2 ft., pipe friction.

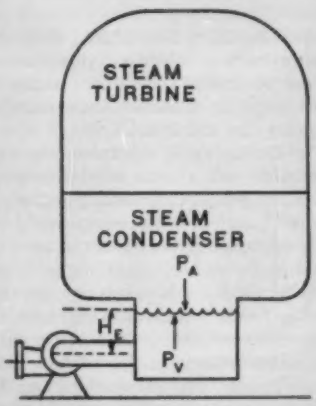
$$LEH = (P_A - P_V) \pm H_E - H_F$$
$$= (34 - 0.6) - 10 - 2$$
$$= 31.8 \text{ ft.}$$

If water temperature is increased to 212° F., then P_V = 33, and

$$LEH = (33 - 33) + 12 - 2$$
$$= 10 \text{ ft.}$$

For other temperatures or liquids, consult vapor charts. Viscous fluids require corrections which can be obtained from charts.

Condensate pump removing water from a steam condenser



H_E = a very low value, often only 2 or 3 ft., and seldom over 5 ft. (Because of methods of construction and expense of excavation, the hotwell is usually just barely above floor level.)
P_A = P_V (absolute pressure above the liquid surface = internal vapor pressure, since the condensate is at the saturation point).
H_F = a negligible value and can be taken as 0.

$$LEH = (P_A - P_V) \pm H_E - H_F$$
$$= 0 + H_E - 0$$
$$= H_E$$

Pumps with specially enlarged inlets are usually used for this service, and extreme care must be taken in their selection because of the very low *LEH*. Cavitation and noisy operation are common occurrences because of lack of available *LEH*.

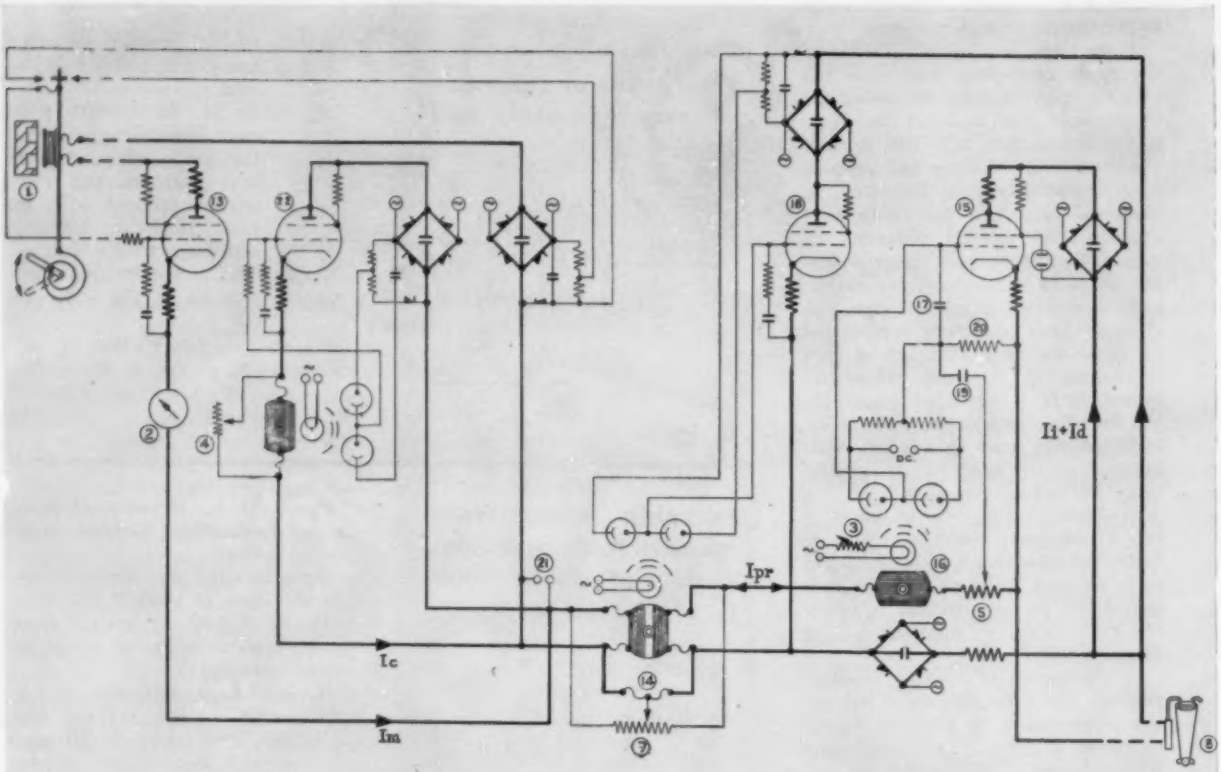


FIG. 1—Basic circuit diagram of the electronic controller itself

The HOW of Electronic Control

THE application of electronic controls to petroleum processing operations is beginning to attract considerable attention in the United States. A few weeks ago, Rock Island Refining Co. put onstream a new UOP Platforming unit at its Indianapolis, Ind., refinery, said to be the first catalytic reformer controlled entirely by electronic instrumentation.

In Great Britain, electronically controlled plants have also been going into operation. One such unit, a 3500 b/d sulfur dioxide extraction unit producing premium grade kerosene at the Llandarcy, South Wales, plant of National Oil Refineries Ltd., was reported in this magazine two years ago[1] and will be described in further detail in this article.

Five inherent advantages for electronic process control have been found by the British plant operators, backing up their original reasons for making this installation:

1—Transmission distance is virtually unlimited. Lag between controller signal and control valve response is thereby eliminated.

2—Controller settings are made by adjustment of potentiometers associated with coils of known resistance. Calibration of scales is therefore more accurate and, in some cases, easily calculated and repeatable.

3—Modes of control and their adjustments are electrically separated in the controller and do not inter-act. This simplifies matching the controller to plant characteristics.

4—Downtime is minimized because controller components can be serviced promptly by replacement, using plug-and-socket electrical connections.

5—Control panel space is kept to a minimum and the graphic type panel can be used for supervisory control. This is possible because control potentiometers can be remote from the actual controller (in the control desk for example), and controllers can be placed in rack mountings at any convenient location.

These factors mean that the petroleum processing industry can have a pattern of supervisory control equipment similar to that already in use in electric power distribution networks. The absence of time lags and distance limitations open up intriguing possibilities in refinery practice by interconnection of units which at present are separate entities. Refining can be visualized as one multiple cascaded process having one central control room. Such a plant can be operated with a small fraction of present-day storage capacity and a substantial reduction in capital outlay.

The instrumentation at Llandarcy is entirely British in conception, design, and manufacture. It consists mainly of level, flow, and pressure control with the associated electrical alarms for high level and excess pressure. The only non-electrically operated instruments in the plant are four temperature controllers.

A conventional type of panel is used in the control room. Automatic control is provided on 17 levels, 4

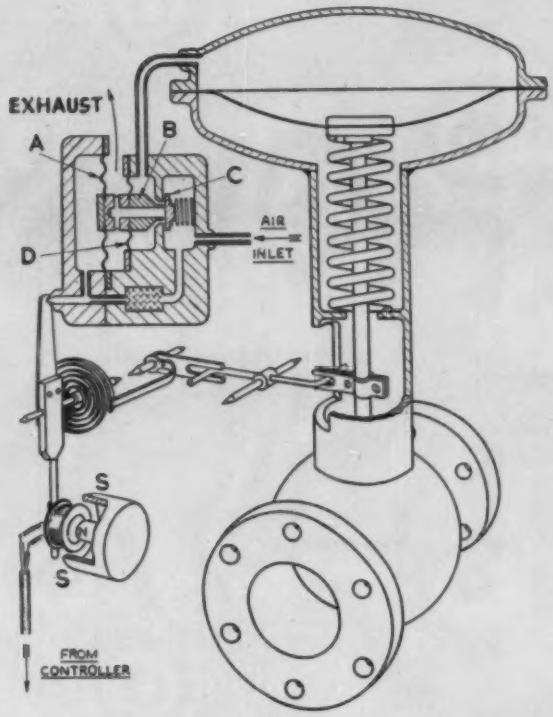


FIG. 2—Valve actuation is by air, in turn remote electrically controlled

Installation shows five processing advantages

By V. S. SWAMINATHAN
London, England

flows, and 3 pressures. The controllers shown in the accompanying photographs are of the type originally installed. They were altered to a type described in this article after operating continuously for over 15 months.

These modifications included the provision of indicators for the measured value and controller output on the covers and a rearrangement of settings concerned with the three terms.

Only one example of cascade control exists on the sulfur dioxide unit: one in which a proportional interface level controller re-sets a flow controller. This is achieved by feeding the output of the level controller into the desired value circuit of the flow controller, terminals being provided for this purpose. The round chart recorders have moving coil milliammeter movements, the charts being driven by flameproof synchronous motor clocks.

The basic circuit diagram of the controller is shown in Fig. 1. A moving coil galvanometer could have been used for the force-balance in place of the pot coil and magnet assembly; and a light beam and photo cells could form the balance detector instead of contacts. Such a photo-electric galvanometer is referred to as a relay in the following description.

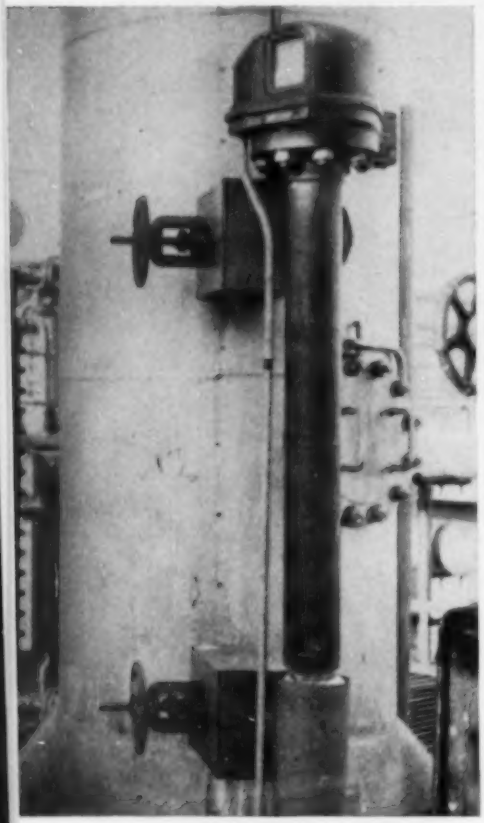
The transmitter (1) in conjunction with the electron tube (13) produces a current *Im*, representing the value of the controlled condition indicated on the meter (2). The desired value at which it is required to stabilize the process is represented by *Ic*, derived from electron tube (22) employing a spring-controlled relay. The value of *Ic* is set by the variable resistance (4) which has a suitably calibrated knob.

These two currents pass in opposition through one winding of galvanometer (14), which deflects according to the magnitude of the error in the system. Such deflection modifies the distribution of light between its photocells, and hence the grid voltage on electron tube (18), until its anode current, *Ipr*, which flows through the second coil (14), re-balances the relay. This current, *Ipr*, is proportional to the error, the sensitivity being determined by the variable shunt resistance (7), which is calibrated for 2 to 600% proportional band.

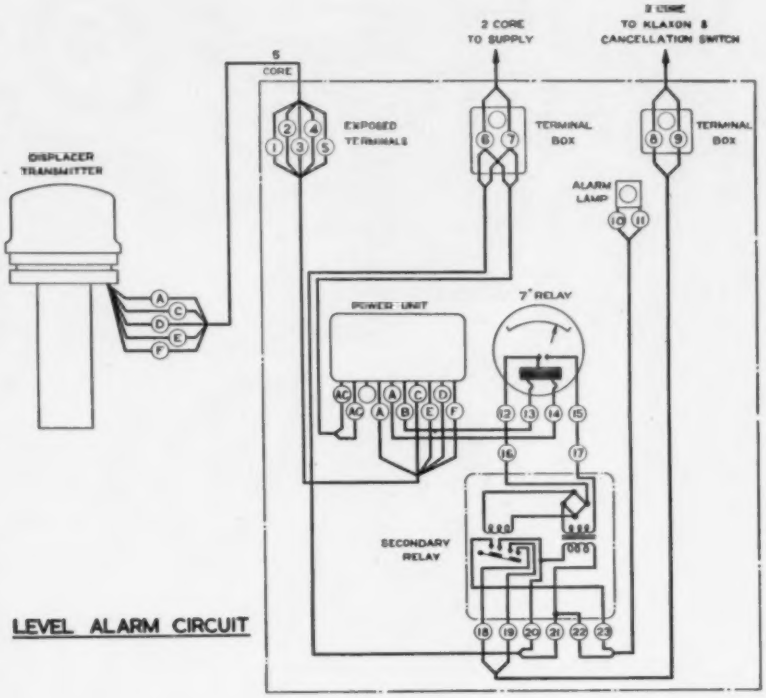
The current, *Ipr*, itself may be used for proportional control, or it may be further integrated and differentiated electrically to provide "two and three term" control. For these terms it is necessary to obtain a signal which varies in magnitude and direction according to the error.

This applies in relay (16), the current, *Ipr*, being biased into a bi-directional form by the rectifier circuit shown below that relay. The photocells of this relay form two arms of a current bridge.

The presence of an error causes an unbalance of light and hence a change in the emission of photo-cells. The condenser (17), therefore, becomes changed according to the integral of the error with respect to time. The rate of integration is determined by the light intensity, and the variable



LEVEL TRANSMITTER of the displacer type as installed in the refinery



LEVEL ALARM circuit diagram

resistor (3) is calibrated for an integration period of 0.2 to 60 minutes.

The rate of change of the error is gaged by the circuit formed by the resistors (5), (2) and capacitator (19). A voltage proportional to the error appears across resistor (5). Whenever the error changes, a current flows via resistance (20) to modify the change on the capacitator (19). The voltage developed across (20) is, therefore, a measure of the derivative of the error over a period determined by the value of resistance (5), calibrated for 0-10 minutes derivative time.

The voltage appearing across the resistor (20) and condenser (19) are applied to the grid of valve (15) whose anode current *Ii* and *Id*, is added to *Ipr*, to form the three-term output of 0-15 milliamp. D.C. A hand control circuit is provided for manual control during the start-up and servicing of equipment.

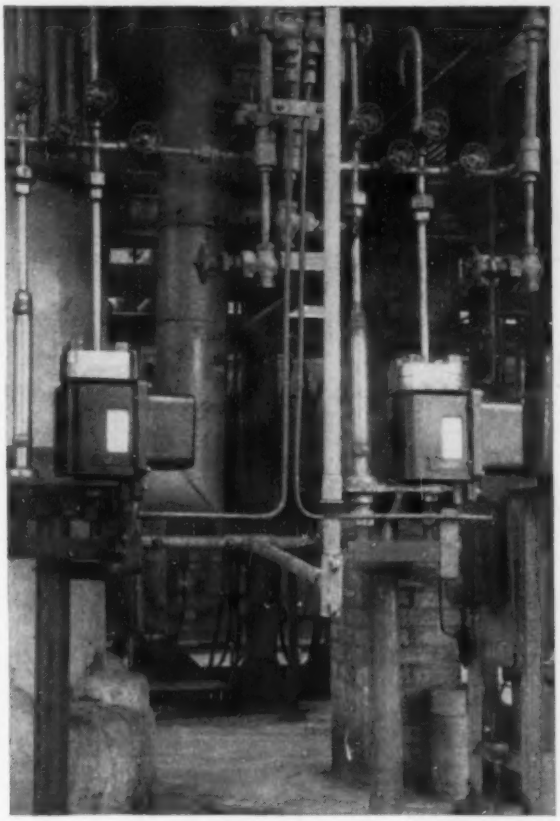
Cascade control is feasible by injecting the output of a further controller into the desired valve circuit at the terminals (21). In the Llandarcy installation a flow control is re-set by the level in a column with this technique.

The valve positioner shown in Fig. 2 is electro-pneumatic. It transmits the electrical signal from the controller into the valve position employing air pressure as motive power. Here the current is applied to a pot coil and magnet assembly. The coil is mounted on a pivoted beam, which also carries a flapper operating in conjunction with the nozzle of a low-bleed type air relay, the output of which is fed to the diaphragm head of the control valve.

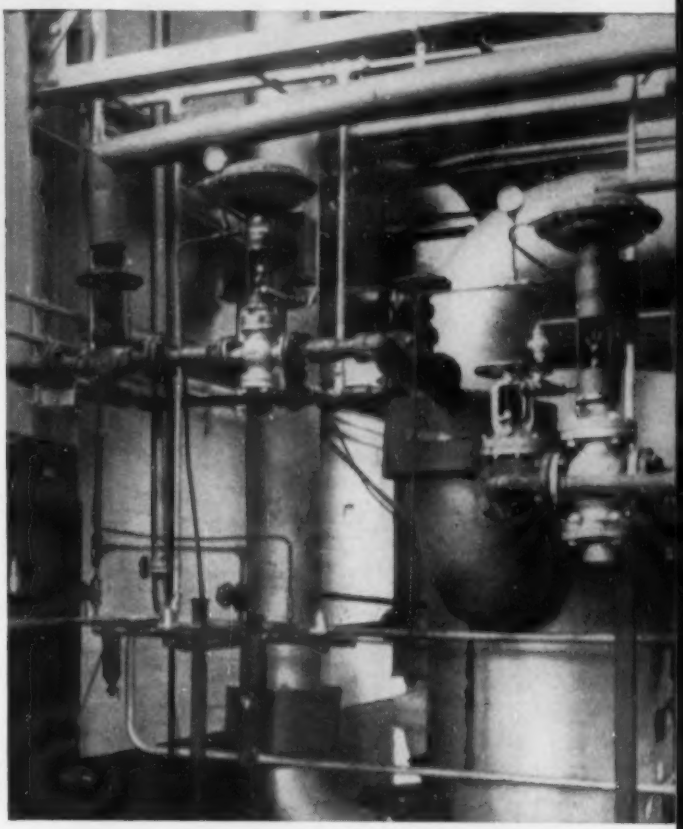
The turning movement of the beam is controlled by a helical spring, whose outer end is coupled to a feedback lever driven by the valve stem, so that, in the steady state, the force due to the electric current is balanced by a force due to the valve position.

The valves (B) and (C) in the pneumatic relay are then closed. Should the controller output current rise, the flapper will cause an increase in pressure on diaphragm (A) of the relay. The plunger (B) attached to this diaphragm opens valve (C) to admit air to the diaphragm head of the valve. Similarly, if the current decreases, a fall in pressure on (A) causes the plunger (B) to exhaust the valve head to atmosphere until the new valve position restores the flapper to its normal position.

Much use is made of ease of connection of electric circuits by plugs and sockets to enable servicing by replacement. The electronic components of the controller are arranged on two removable trays to minimize out-of-service time during a fault. The tray taken out of service may be



FLOW METER as installed in the plant



PRESSURE TRANSMITTERS as installed at the unit

examined and tested in the instrument repair shop at any convenient time.

To facilitate such testing, a device known as the process analogue is provided. In this, the capacities and time lags of a process plant are simulated by electrical networks, and with its aid the complete operation of a controller may be tested rapidly, while various plant disturbances are simulated and repeated at will.

An alarm system is provided to give an audible and visual warning should a high level occur in two traps connected to the suction side of two compressors. Displacer level transmitters furnish a signal current to an alarm circuit. The signal is received by moving coil relays having contacts which may be adjusted to any predetermined level.

In operation, the moving coil relay energizes a secondary relay, which closes the circuit to warning bells and lamps. Should the alarm conditions be ignored for any reason, a second moving coil relay which contacts set at a higher level, automatically shuts down the appropriate motor-driven compressor.

A similar alarm system is employed to give warning should the steam condensate from the evaporators be contaminated with SO_2. The detector is a conductivity meter connected to an ohmmeter movement type alarm relay. The contact is set at a value representing high conductivity due to contamination by SO_2. Cancellation buttons are provided for cancelling the audible signal and leaving on the visual signal, and these are arranged to automatically reinstate the alarm circuit when normal conditions are resumed.

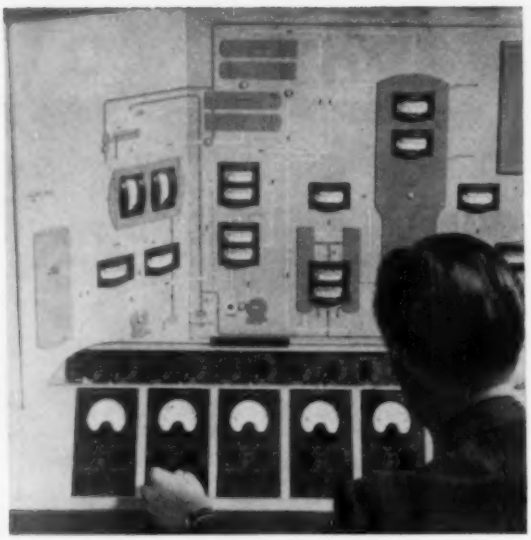
Displacer level transmitters are mounted on columns. The bodies are of welded steel construction and suitable for a working pressure of 600 psi. The displacer float and bellows seal are in stainless steel. An external adjustable spring is provided which enables the units to be calibrated for different fluid densities.

The flow meters display clearly the simple stainless steel construction of the manometer and the transmitting unit which clamps round the measuring tube on the right-hand side. The meters are constructed for a working pressure of 1,500 lb. psi.

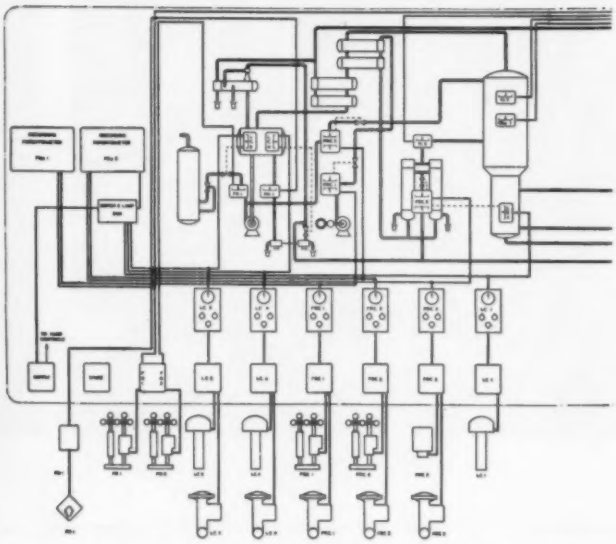
The pressure transmitters consist of pressure elements which vary the torque of a helical spring proportional to pressure. The torque is balanced by the transmitter coil.

The centralized control desk forms a self-contained unit and embraces controllers, indicators, recorders and control adjustments. The indicators are arranged to form part of a graphic diagram. The entire scheme comprises 24 measuring and transmitting units

GRAPHIC CONTROL PANEL takes the form of a compact desk unit; lower photo is detailed close-up



DETAILED CLOSE-UP of the graphic control panel



SCHEMATIC DIAGRAM of the circuitry in the desk control panel

for flow, pressure and level, while six vapor pressure thermometers are used as originating movements to convert pressure into a measuring current of 0-30 milliamps.

Two self-balancing recorders are employed for recording flow. A further one operates from thermocouples and is utilized for temperature. Manual selection of 24 points is also provided by a self-balancing potentiometer indicator.

Controller adjustments are mounted on the front of the desk below the graphic diagram. Those for proportional, integral and derivative settings are protected by a sliding cover which may be locked if necessary. The desired value, manual and hand-auto controls are mounted on miniature panels together with an indicator showing the output of the controller or the position of the valve.

The input to the self-balancing potentiometer flow recorder is 10 millivolts and is derived from the voltage drop across a shunt carrying the flow transmission current. Flow meters are provided with current squaring balancing coils; and, hence, the transmitted current is linear with flow.

Permanent flow records are provided by six- and twelve-point recorders operating from ten flow transmitters. The twelve-point recorder renders available a further six records which may be selected by switches. Each switch has two positions, enabling six out of twelve measurements to be recorded. The selected records include certain pressure, flow and level measurements, for which permanent records were deemed unnecessary.

In the graphic diagram, the measured quantities are indicated on miniature, edgewise, milliammeters arranged as part of it. In some cases, duplex indicators are used; the upper scale indicates the measured value and the lower, the desired one, the latter being controlled by the calibrated desired value adjustments. The manually selected temperature points are depicted by colored lights on the diagram. These light up to confirm the particular selected point. The controller components are mounted on trays in air purged cases arranged in banks and contained in the rear of the desk. The trays may be readily removed for replacement or inspection.

References

(1) "Electronics Control Refining Unit," by Leo Walter, PETROLEUM PROCESSING, August, 1952, pp. 1126-7.

Operation Alpha

— was first use of old slate quarries for seasonal storage of refinery products

— has the largest sectional pontoon roof ever built for an industrial application

— included a well-organized community education program to allay fears of hazards

By V. B. GUTHRIE
Associate Editor

FINISHED heating oil from the Esso Standard Oil Co. Bayway refinery at Linden, N. J., on Sept. 8 started flowing into a converted slate quarry 65 miles distant, at Wind Gap, Penna., for storing until the winter starts.

Operation Alpha is fittingly named for several firsts, the principal one being this original use by an oil company of open pits for the long term seasonal storage of petroleum products. The achievement follows two years of development work by the Esso engineers.

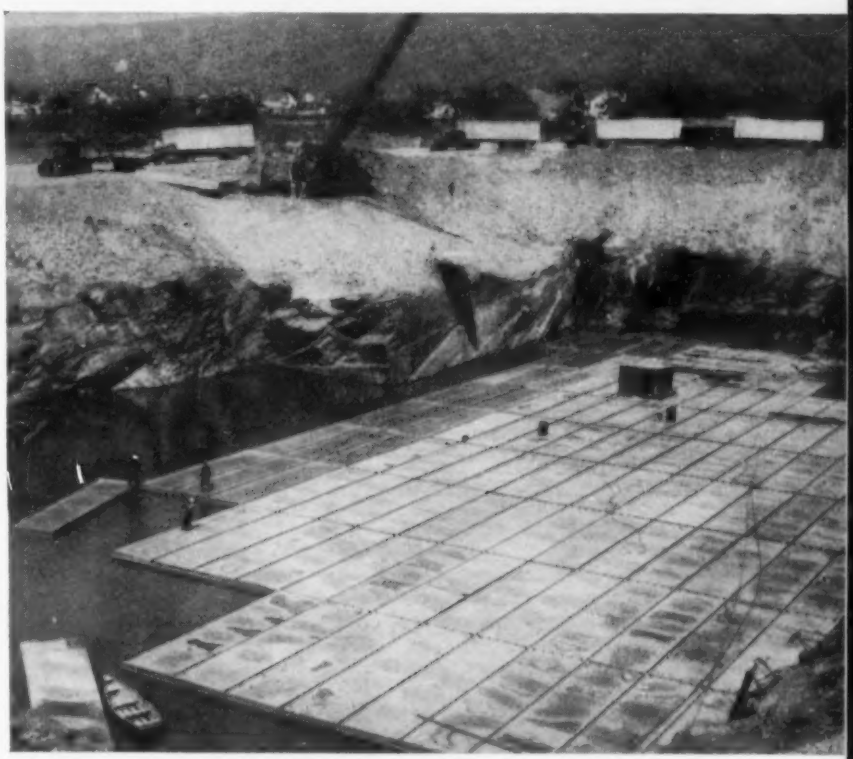
Oil from the refinery is now moving into the unique storage at the rate of 5500 barrels daily, through the old Tide Water 6-in. crude line, which was leased by Esso for this purpose. The line runs from Bayway and is within 1500 ft. of the Alpha quarry. In the winter the oil will be returned downgrade to the refinery at the rate of about 8000 b/d, for shipment to Esso distributing points in New York and New England.

The quarry at Wind Gap selected for the first oil reservoir of this type is an open pit, ranging up to 225 ft. deep, 56,000 sq. ft. in area, a good share of its depth being taken up by water. It has an oil storage capacity of 1,000,000 bbl., not all of which will be used this coming heating season. Esso has purchased or holds under option, all together, nine slate quarries in this area of Pennsylvania, with a total potential oil capacity of 8,000,000 bbls. This is equivalent to the annual heating requirements of 225,000 average homes.

The Alpha and similar pit storage projects represent the company's plan to relieve wide fluctuations in refinery operations between summer and winter by providing ample capacity for the buildup of heating oil inventories during the summer.

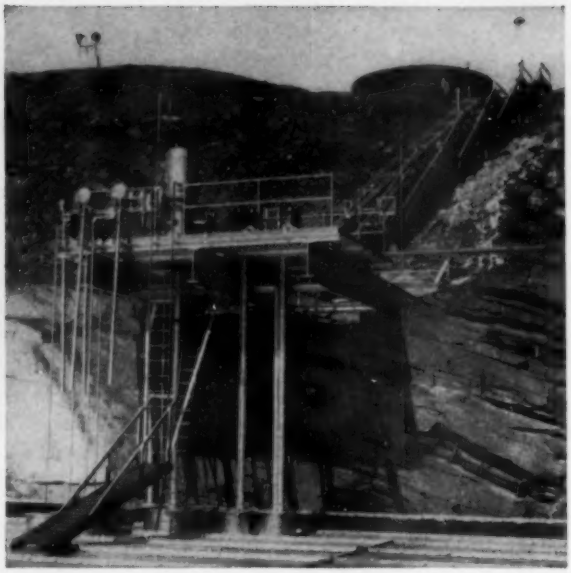
"Successful demonstration of the feasibility of this type of reservoir may be the solution to the industry's seasonal storage problem," stated H. G. Mangelsdorf, Esso director and general manager of manufacturing. "The ability to put into 'dead' storage large quantities of heating oil produced in the slack summer months, for delivery at the height of the heating season, could reduce substantially the wide seasonal swings in refinery production and product transportation. Our studies indicate there are many mines and quarries that could be used for this purpose."

The methods developed by Esso engineers for using open pits with relatively straight walls for oil storage

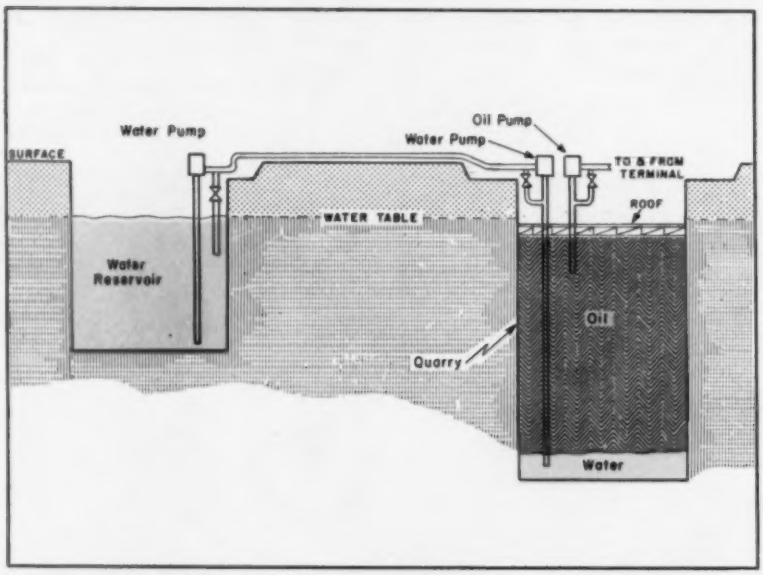


BUILDING A 1-1/3 ACRE "FLOATING ROOF" at Esso's quarry-for-oil-storage project

PONTOONS WERE HELD TOGETHER at top flanges by "spring clips," and then welded—at clips only



OIL AND WATER FLOW is handled by this pump-works, with suction and discharge lines passing through pontoon roof



HOW THE OIL QUARRY WORKS is shown in this engineering sketch (oil layer height is exaggerated for explanation)

were described when the Alpha project was announced a year ago.* The first requirement is that the walls must be permeable, so that a balance can be maintained between the level of the water table in the surrounding area and the oil level in the pit. The oil company's development work has been with slate quarries but other permeable types include limestone, cement, trap rock, and clay pits. Metallic ore mines were eliminated from the studies because of the possible contamination of the stored oil.

The operation includes two adjacent quarries, one of which is a water reservoir to control the level of oil in the other, the oil storage pit. As oil is pumped onto the top of the water in the oil reservoir, the same volume of water is withdrawn at the bottom and is transferred to the water reservoir to maintain the surface level in the oil quarry at least 10 ft. below the water table in the surrounding area. When oil is pumped out, water is pumped in from the water pit for the same purpose. (See drawing.)

Since the oil level is below the level of the surrounding water table, the water pressure on the outside of the quarry is greater than the pressure of the oil in the pit. The quarry is therefore sealed effectively against oil leakage.

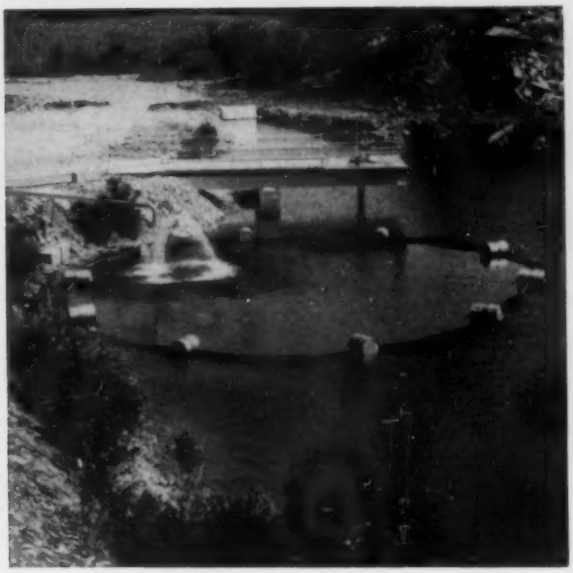
Any seepage in the surrounding area is in the direction of the quarry. The water seeping in joins the water below the oil, and water is pumped out to maintain a practically constant surface liquid level in the pit. For additional protection against contamination of nearby surface waters, a series of entrainment baffles in the water pit and its outlet stream trap any oil which might escape in the water withdrawn from the oil storage pit.

Major engineering feature of the Wind Gap installation is the sectional pontoon roof, said to be the largest ever built for industrial use. The roof covers about one and one-third acres. It serves to cut down evaporation losses from direct sunlight and to protect the oil from airborne contamination and wildlife.

The roof is made up of 240 steel sections, weighing almost three tons each, which ride on the surface of the oil. The rectangular, box-like sections are 32 ft. long, 7½ ft. wide, and 1 ft. deep, and made of 3/16-in. steel. Irregularly shaped sections which were required to make the roof conform to the contour of the quarry walls were

*"Old Quarries for Oil Storage," PETROLEUM PROCESSING, August, 1953, pgs. 1168-69.

TO FIT ODD-SHAPED QUARRY, certain pontoons were made irregular in shape



WATER RESERVOIR adjacent to main oil storage pit. Note entrainment baffles to trap contaminants and oil

measured and fabricated on the site.

The sections were welded together in place. The pontoon roof is not attached rigidly to the pit walls. It is fastened by means of a neoprene apron to a steel shelf which is bolted to the wall. The width of the shelf varies up to 3 ft.

The apron allows the roof to move up and down vertically about 1½ ft., which is more than the extent of vertical movement anticipated under the method of balancing the oil and water volume to maintain a constant liquid surface level in the pit.

At intervals around the quarry, cables and springs are attached to the walls and to pontoons out from the edge of the roof. These attachments are for the purpose of centering the roof in case of a tendency to drift to a wall. The roof has two product inspection hatches, for taking samples or a manual gage of the oil. Each pontoon has a pipe through it to drain water from the surface down into the oil below and also a pontoon inspection hatch to check the interior for water leaks.

The Walter Kidde Co. was in charge of construction for the Alpha project. The roof was designed and installed by the Hammond Iron Works.

The economics of quarry oil storage will have to be studied for a year or more, through the Alpha installation, before such projects can be termed successful, the oil company officials state.

The pit installations will cost less than half the cost of the same volume of steel tankage and there are additional savings through doing away with the need for painting tanks and for keeping up dikes, firewalls and other fire protection measures. There would be savings in insurance costs, also, through the reduction of the fire risk.

One important item of cost for mine and quarry storage which is not experienced with steel tankage at or adjacent to refineries comes through the product pipeline system required.

The cost to Esso of moving heating oil by its leased 6-in. line 65 miles to Wind Gap and the same distance back to Bayway is said to be around 15¢/bbl. Where a line had to be built of up to 12-in. capacity, at a cost of around $50,000/mile, the initial capital investment required would be large but the transportation cost factor would tend to equalize that of Esso with its leased line.

Because of the volume of product involved, together with the cost of converting the quarry or mine and providing for pipeline transportation, this type of storage, if used, is likely to be a cooperative project for the smaller refineries, or for a few large companies individually, or as a national project.

A good public relations program put the 2000 residents of Wind Gap "in the know" on the Alpha project long before work was actually started. The quarries are at the edge of the town, with residences on one side and farms on the other. Esso considered it essential that all fears of the community be allayed as to any public hazard through the storage of oil in one pit and also as to any possible contamination of the surrounding underground and surface waters.

First, a series of open meetings was held with the Wind Gap town council. The public was invited and Esso engineers and company officials from New York explained in detail what was proposed, and the protective measures to be carried out. Questions from the floor were answered in all detail.

Secondly, the Alpha oil storage project was discussed by Esso officials with the wildlife associations active in this part of Pennsylvania, also with state groups concerned with water pollution problems. The steps taken to prevent the pollution of surface waters in fishing streams and the contamination of underground waters in the nearby farming territory were gone over in detail with these agencies.

Thirdly, local firms and supply houses were used in the construction work as much as possible. The bulletin board at Alpha headquarters lists 20 firms in Wind Gap and nearby towns who have had a hand in the work. An open house for the community is planned for the future, to demonstrate the enterprise under way.

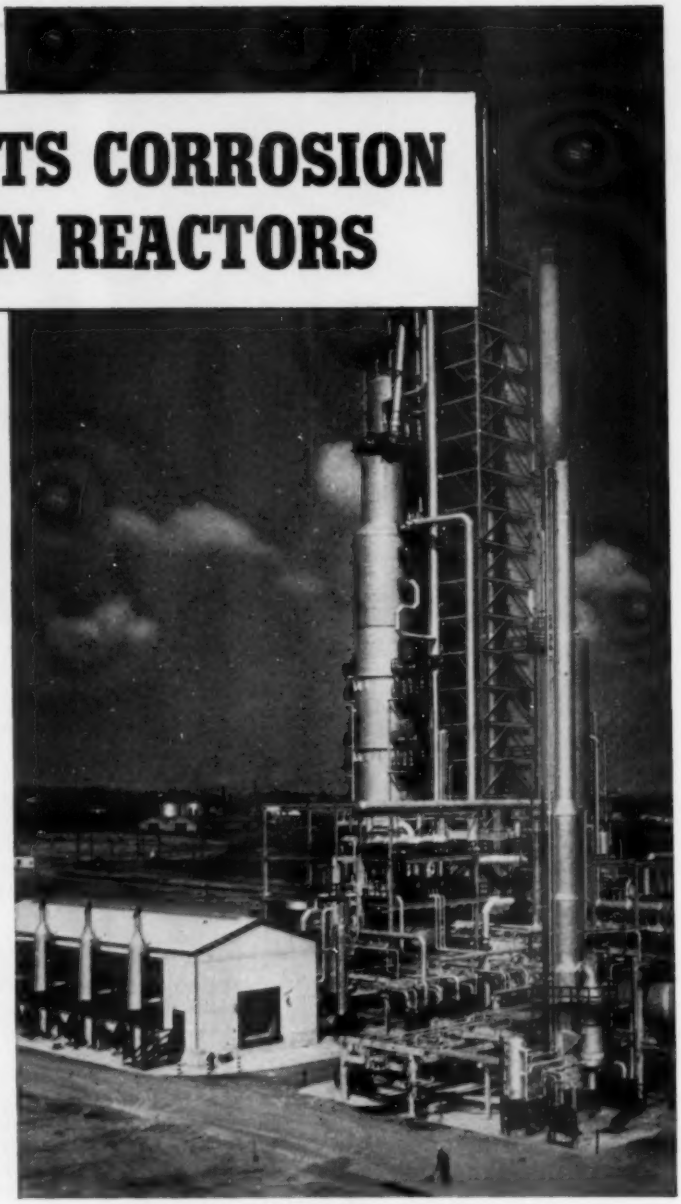
The educational work to date has been so thorough, however, that when heating oil actually began to flow into the reservoir only a few blocks from the center of Wind Gap, the fact seemed of little interest to folks in the stores and on the street corners.

CLAD STEEL CUTS CORROSION IN NEW TWIN REACTORS

This 25,000-barrel-per-day Houdriflow cat-cracker features twin reactor-kilns built into one large vessel for the first time. But designing this unit presented many problems. The reactor, for instance, had to resist corrosive action of the crude fraction at temperatures in the neighborhood of 950°F. To get *economical* corrosion resistance, stainless-clad steel was specified for the cone, shell and an internal head.

To get economical performance like this in other major units of this refinery, stainless-clad steel was specified for the atmospheric, vacuum and synthetic crude towers and for the flash fractionator to minimize corrosion, downtime and equipment failure. The light layer of cladding, inseparably bonded to the carbon or low-alloy backing steel, gives the performance of expensive solid high-alloy plate at much lower cost. Strength and rigidity are supplied by the backing plate.

Now this refinery is ready to meet increasingly competitive conditions as the result of an expansion program that raised operating efficiency and tripled throughput. While still in the planning stages, the refiner's engineers called on the equipment builder to help translate their ideas into the specialized equipment needed. His particular knowledge of fabricating techniques utilizing clad steel helped put this refinery ahead in output and profit. You, too, will find that it pays to consult your fabricator early in your planning for equipment that is lower in cost, longer lived and requires less maintenance.



Clad steel in this Houdriflow cat-cracker provides economical corrosion resistance at high temperatures

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PETROLEUM PROCESSING

OCTOBER 1954

Petrochemical Processing Section

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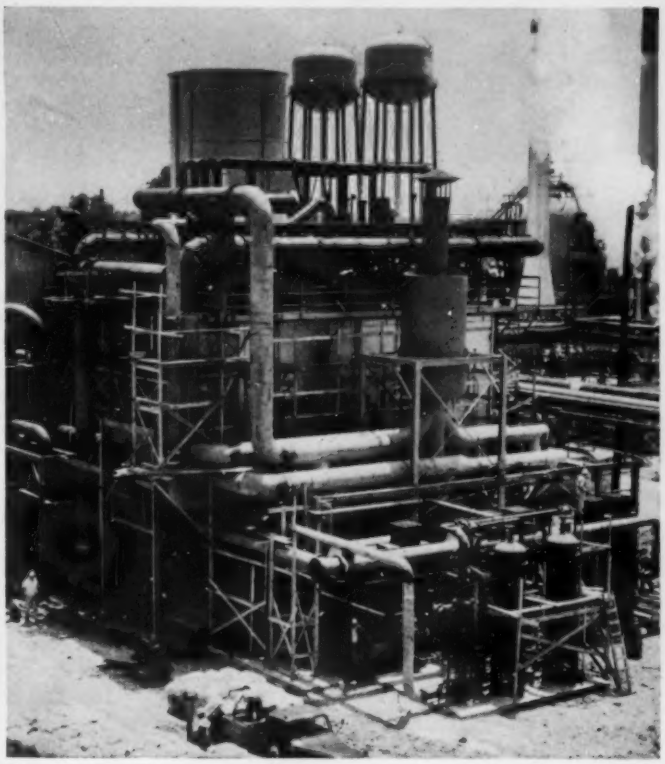

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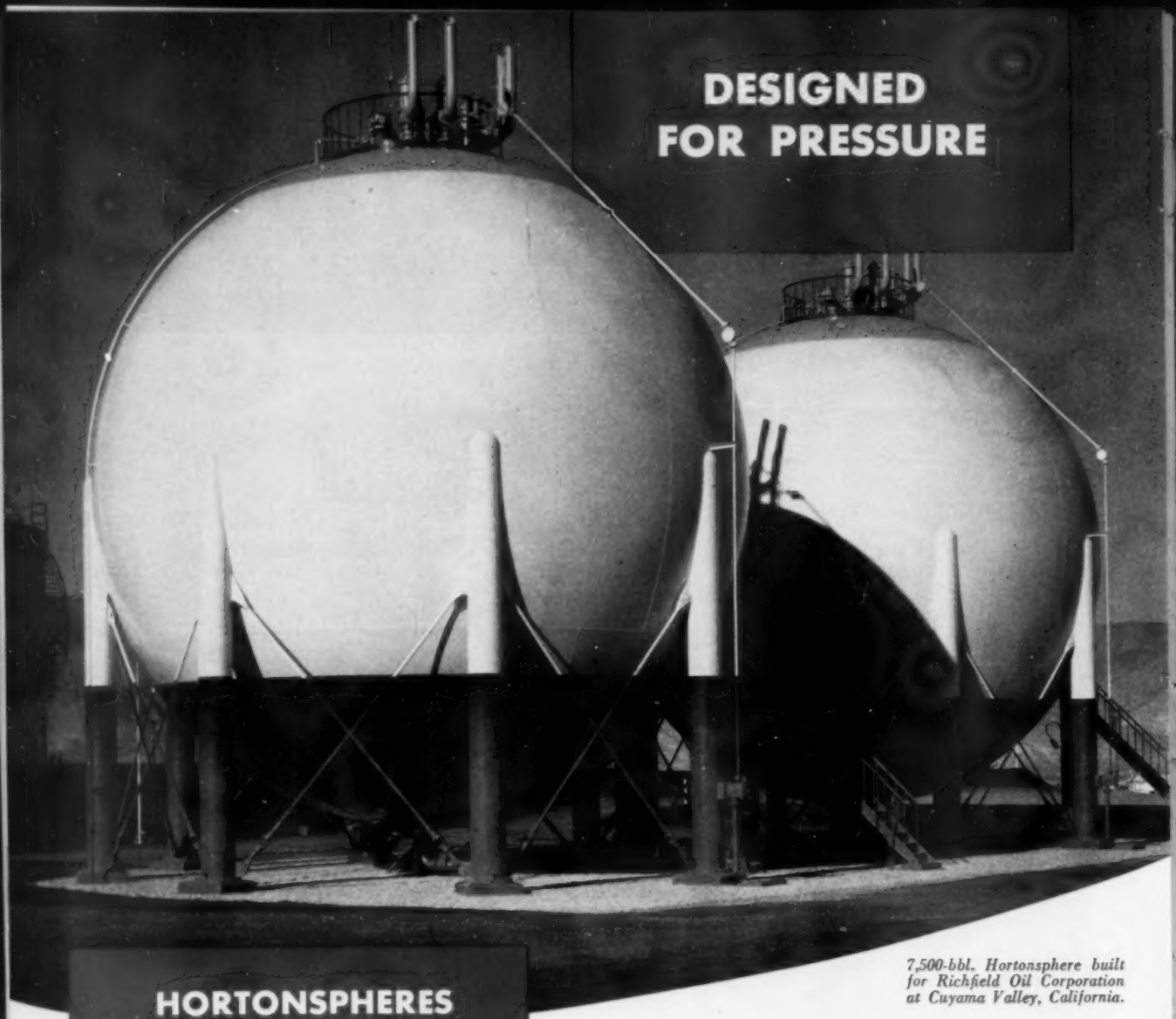

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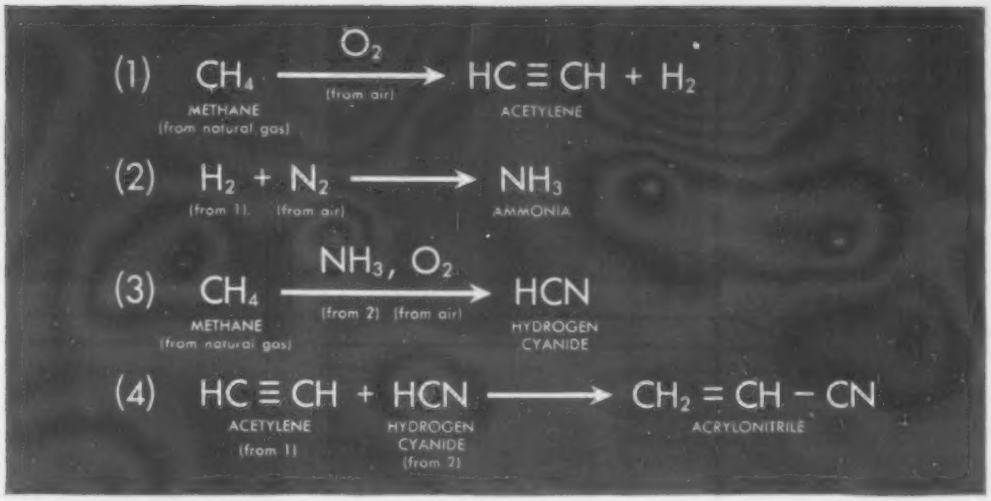

(1) CH4 METHANE (from natural gas) O2 (from air) HC ≡ CH + H2 ACETYLENE
(2) H2 (from 1) + N2 (from air) NH3 AMMONIA
(3) CH4 METHANE (from natural gas) NH3, O2 (from 2) (from air) HCN HYDROGEN CYANIDE
(4) HC ≡ CH ACETYLENE (from 1) + HCN HYDROGEN CYANIDE (from 2) CH2 = CH – CN ACRYLONITRILE

FOUR PRINCIPAL REACTIONS tell the process story of how American Cyanamid goes . . .

From Natural Gas to Acrylonitrile

Via acetylene, ammonia, hydrogen cyanide

By D. P. THORNTON, Jr.
Southwestern Editor

FIRST commercial operations at the new $50,000,000 chemicals plant of the American Cyanamid Co., at Fortier, La., near New Orleans, will be for the production of acrylonitrile. Large tonnages of sulfuric acid, ammonium sulfate and anhydrous ammonia are programmed for future production. All will stem from the simple raw materials of air and natural gas, plus sulfur for sulfuric acid used in purifying intermediates.

The present designed capacity of the show-place Fortier plant is 50,000,000 pounds of acrylonitrile annually. While used in many ways and in many industries, the company visualizes most of its output in the immediate future will be for rubber, plastics, synthetic fibers, soil conditioning compounds and as a chemical intermediate.

Present captive intermediates used for acrylonitrile production include acetylene, ammonia and hydrogen cyanide, all starting materials for a host of chemicals in addition to acrylonitrile. Principal by-product now is ammonium sulfate. Probably significant amounts of vinyl chloride will be recovered in the near future.

Acrylonitrile

The acrylonitrile process installed at Fortier made its debut from the pilot plant, where it had been under periodic investigation by American Cyanamid since 1938. It involves the reaction of 99% pure acetylene with hydrogen cyanide of at least 50% purity and steam in the presence of a "liquid catalyst, under conditions of substantially atmospheric pressure and moderate temperatures."

The reactor vapor is a complex mixture of acrylonitrile, water, unreacted acetylene and hydrogen cyanide, lactonitrile, cyanobutadiene, vinyl chloride, vinyl and divinyl acetylene and probably other similar compounds. The limitations of pilot plant data are responsible for the fact that no specific provisions were made in initial construction of the plant for purifying the by-products of this reaction. After a backlog of commercial experience is developed and pilot plant indications are confirmed, it is probable that quantities of such by-products as lactonitrile and vinyl chloride will be recovered in pure state. Cyanamid already is a producer of lactonitrile.

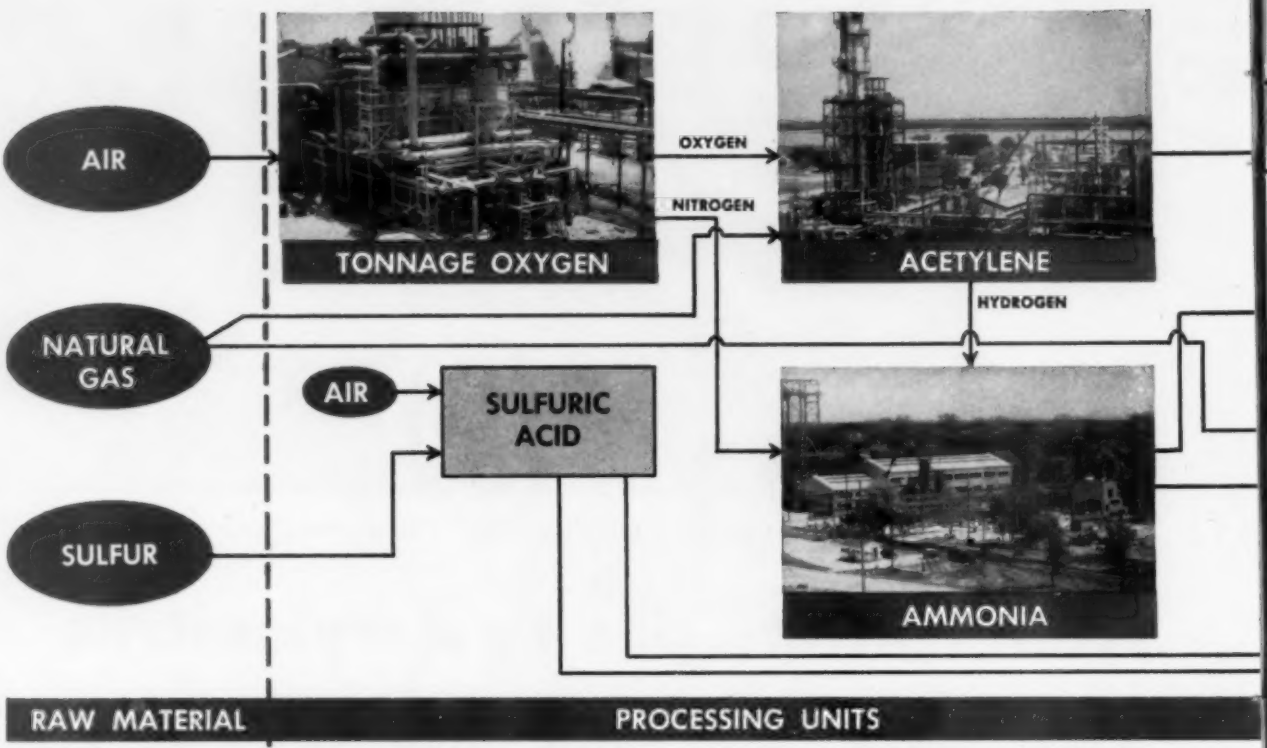
Cooling, followed by a water wash, separates the nitriles, cyanobutadiene, HCN and some of the vinyl chloride. The remaining vapors include unreacted acetylene, the higher acetylenes, carbon dioxide, if present, and the balance of the vinyl chloride. The wash water is stripped, the vapors being passed through a series of distillation columns to recover high purity acrylonitrile.

Acetylene

Acetylene is made at the Fortier plant by the German B.A.S.F.* process, whereby oxygen and methane are separately preheated (in gas-heated coils) to 500-600° C. (932-1112° F.), mixed and passed through burners of the B.A.S.F. design. Each burner produces about eight tons of acetylene per day. The gases are rapidly quenched with untreated but settled river water to prevent decomposition of acetylene from the 2700° F. synthesis temperature and to help knock down some of the free carbon produced as a side-reaction.

The yield of this process is controlled by the accurate proportioning of oxygen with the gas (a molar ratio of approximately 0.6 to 1, oxygen

* Badische Anilin und Soda Fabrik.



PROCESS RELATIONSHIPS at American Cyanamid's new plant, showing raw materials, main processing units, principal products

to gas, is used), very short residence time, and rapid quench to below acetylene decomposition temperature (which sets in about 800° F. and increases rapidly as temperature rises).

The gases are further cooled with water and then passed through a soot filter (moist coke) to remove the remaining free carbon. The acetylene unit effluent is next compressed to a convenient level for the recovery system and absorbed in a selective solvent of unstated nature, to recover acetylene from the gaseous stream.

The rich absorbent is stripped, virtually pure acetylene being taken from about the middle of the column. The stripper off-gas is recycled. Final purification is achieved by flashing off the solvent and recovering the contaminants by decantation and filtration. Acetylene made from natural gas by the B.A.S.F. synthesis and purification system has been found to be fully equivalent to purified carbide acetylene in various syntheses.

The denuded tail-gas from the acetylene absorber goes through three stages of purification for its hydrogen content. The stream consists principally of hydrogen, carbon monoxide, carbon dioxide and unreacted methane. First in line is the familiar carbon monoxide converter, employing an iron oxide catalyst, wherein carbon monoxide reacts incompletely with steam to produce carbon dioxide and more hydrogen. Next is a monoethanolamine and caustic scrub which removes carbon dioxide and finally a cold wash. The purified tail-gas is approximately 80% H_2 and 20% N_2.

Hydrogen Cyanide

Starting materials for hydrogen cyanide synthesis are ammonia, natural gas and oxygen (air), in the presence of a platinum catalyst in the form of gauze, at about 1832° F. Reaction products include carbon dioxide and monoxide, water vapor, hydrogen cyanide, and unreacted methane and ammonia. The hot stream is cooled through two waste heat boilers in parallel, producing saturated steam at 150 psig.

Further cooling is acheived with conventional coolers, following which the reaction products are passed through a wash tower where ammonia is removed by sulfuric acid. Ammonia must be removed not only because it is a contaminant in later processing, but also because its presence promotes polymerization of HCN, as do caustics. Such polymers are apt to decompose readily.

Since hydrogen cyanide is extremely soluble in water, recovery from the remaining contaminants is achieved simply by absorbing it in water under such conditions that carbon dioxide is not also dissolved. It is subsequently stripped as a relatively pure product, ready to use. The off-gas from the absorber has a heating value of about 60 Btu. per cu. ft. and is burned under the boilers with other waste gases.

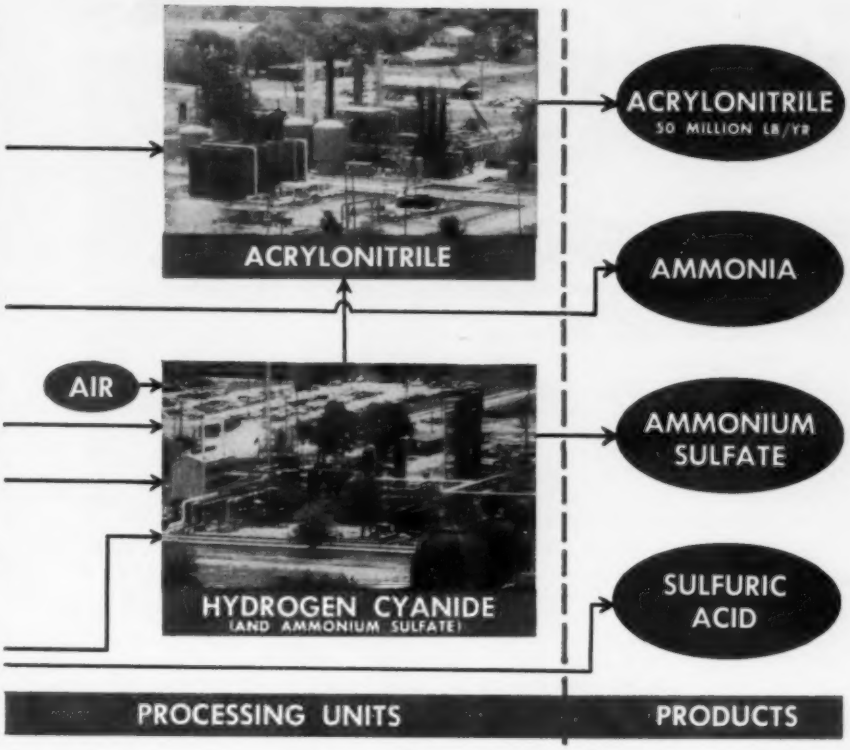
The hydrogen cyanide is cooled to below its boiling point of 99° F. by exchange with Freon and stored as a liquid in refrigerated aluminum tanks.

The acidic sulfate wash stream from the first purification step is neutralized if necessary with more ammonia, then concentrated to remove excess water. The ammonium sulfate is crystallized from this solution in a conventional package unit designed by Chemical Construction Corp. Crystals will be sold locally.

Ammonia

At the ammonia unit, the purified hydrogen-nitrogen stream is adjusted to stoichiometric composition for ammonia synthesis with pure nitrogen and the mixture compressed to 4500-5000 psig. The process is the standard Chemical Construction Corp. ammonia synthesis, employing a promoted iron catalyst.

Features at this unit include two 2500 Hp. gas-engine driven Cooper-Bessemer compressors to compress the fresh feed, two electrically driven 300 Hp. recycle compressors, and two electrically-driven nitrogen compressors. Purity of the fresh hydrogen stream particularly will be checked by



an infra-red spectograph since it will be undesirable to have oxygen-containing compounds or acetylene or its homologues present in this stream. However, actual process control of this and the nitrogen stream will be by conductivity measurement, as oxygen likewise is undesirable from a catalyst-life standpoint and more apt to be present than the acetylenes.

Oxygen

Oxygen for acetylene production is supplied by a 320 ton/day unit imported from Linde in West Germany, which is the latest low-pressure design of its type. The accompanying nitrogen produced is used to purify hydrogen for ammonia manufacture and as the other raw material in ammonia manufacture. In addition, utility lines supply nitrogen as a purge medium to various other portions of the plant.

Only one complication is anticipated in the operation of the oxygen unit. Due to the extremely low temperatures involved, the remote possibility of overloading the unit with solid acetylene will require a more frequent purging cycle to eliminate this material and its explosive homologues, while a close watch will be kept for them in intake air.

A single steam turbine-drive Clark air compressor furnishes 30,000 Scfm. to this unit at 90 psia. Oxygen product is received by an Ingersoll-Rand centrifugal compressor at 15 psia., to be boosted to the desired pressure for the acetylene unit. This compressor is quite unusual since it can neither be internally lubricated (because of the presence of oxygen) nor can there be metal-to-metal contact between any moving parts where high temperatures might be generated. As is normal with oxygen equipment, the interior mechanism of this machine was carefully degreased during installation. All lubricated bearings are external to the compressor casing for this reason, also. Compressor impeller and shaft are of stainless steel to resist corrosive attack.

Air in the Linde unit is expanded through three turbines to achieve initial refrigeration until the exchangers are brought down to the —300° F. temperature required for oxygen liquefaction. When operations are lined out one turbine will be sufficient to maintain normal refrigeration needs. The turbines drive electric generators simply to achieve power recovery.

Other Aspects

The sulfuric acid unit at Fortier is a typical Chemical Construction package unit, producing 100 tons daily of 98% acid from Louisiana mined sulfur with a yield of better than 97%.

Natural gas used at Fortier both in processing and also for major fuel requirements must pass the lead acetate test for sulfur compounds. Components are principally methane, some ethane, and smaller amounts of propane and higher hydrocarbons. Principally the plant is interested in the uniformity of composition, particularly for that portion used in making hydrogen cyanide. Gas is purchased from dedicated reserves of The Texas Co. which are not available supplies for a public utility gas pipeline.

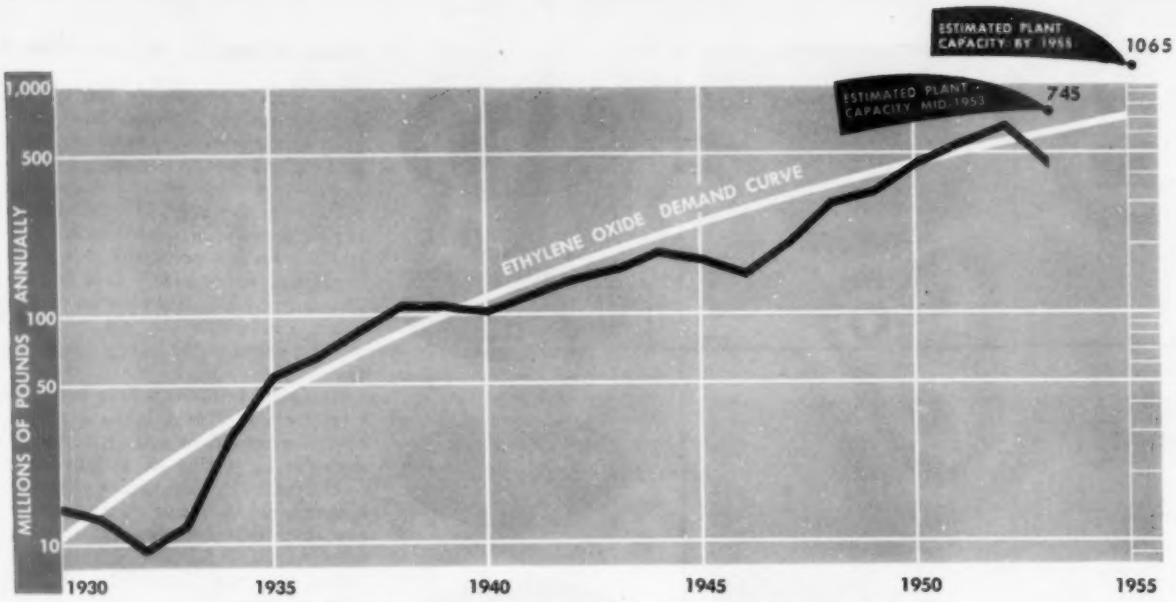
Statistical methods will be used extensively by Cyanamid to establish operating conditions and correction of variables in placing its various units on-stream. By evaluating existing commercial operating data, where available, and pilot plant information for acrylonitrile, initial operating conditions will be determined statistically. After the start-up, certain operating conditions will be varied slightly and the effects upon yield evaluated to establish trends and the optimum operating conditions. Eventually, operating charts will be prepared to guide future operations.

As a side-light, another anticipated benefit from these statistical studies, especially in operations new to Cyanamid, will be the detection of accumulation of materials in recycle systems which may not have been anticipated from pilot plant work. It is hoped also that these studies will signal "those things which otherwise just happen:" operators' errors, instrument miscalibrations and gradual malfunctioning of critical equipment. These occurrences result in both rapid and gradual changes in yield or operating conditions. It is believed that the statistical treatment of data will indicate the nature of corrective measures to be taken.

Personnel to operate the Fortier plant of the American Cynamid Co. will include about 270 hourly and between 175 and 200 salaried people. Unit operators were selected largely on the ratings given by a New Orleans firm which specializes in testing individuals for their qualifications and abilities for different types of work.

More than a year ago 25 recent chemical engineering graduates were hired and farmed out at Cyanamid plants for training to later become shift foremen at Fortier. Together with the experienced men for the higher supervisory and technical jobs, they will form the plant technical staff.

Design and construction of the Fortier plant was entrusted to Chemical Construction Corp., a wholly owned Cyanamid subsidiary. The craft labor and first line supervision came from the New Orleans area.



ETHYLENE OXIDE DEMAND in the U.S.—going up, but not as fast as plant capacity

Status Report On . . .

Partial Oxidation of Ethylene

TECHNOLOGY—*Direct oxidation favored over chlorohydrination*

ECONOMICS—*Production capacity going up faster than demand*

By PETER W. SHERWOOD
Chemical Engineer
White Plains, N. Y.

THE first weeks of August, 1954 saw the first significant signs of the predicted recovery of the ethylene oxide market from a temporary slump. During this period, the price of ethylene oxide took an upward turn of 1.5¢ to establish a level at 15¢/lb.

Thus, ethylene oxide may already be returning to its position of stability in which it had been temporarily threatened by the completion of important new plant capacity, adverse seasonal conditions, and active inroads made by competitive chemicals into its primary markets.

What the immediate future will hold for ethylene oxide depends to a great extent on the severity of the coming winter and its effect on ethylene glycol sales for antifreeze purposes. The mild winters of 1952 and 1953 have left their mark. As recently as late July, 1954, ethylene oxide was quoted at 13.5¢/lb. in tank car lots, down from 19¢ only one year earlier.

The trend is completely paralleled by the recent price history of ethylene glycol, the oxide's primary derivative, as indeed the two commodities invariably move jointly. Thus, ethylene glycol, after a period of relative price stability, rose from 9¢/lb. in 1946 to 14.5¢ in 1948-50, and attained a level of 17¢ in 1952 and 1953 prior to its decline to 11.5¢ in late 1953. Current (September 1954) quotation appears at 13¢.

Today, ethylene glycol production consumes nearly 70% of all ethylene oxide produced in the United States. It is, however, apparent that there is a gradual change in consumption pattern now afoot which should tend to stabilize and bolster the long-range outlook for this prime petrochemical. The shift is illustrated by Table 1, which gives estimated distribution during three key years [1, 2].

Historically, ethylene oxide has exhibited a growth curve which is rivaled by few chemicals. This expansion, illustrated in the chart above, shows a continuous upward trend since 1933, interrupted only by temporary decline during three years. Even today, developments are on the horizon which may boost ethylene oxide production well above present forecasts. Among the more important outlets, which still defy assessment, are ethylene oxide-terephthalate films, and the use of ethylene glycol in thermosetting plastics of the polyester type.

The bright production history and long-range outlook has naturally stimulated considerable plant construction. Ethylene oxide capacity on stream in mid-1953 was estimated at 745 million lbs. per year. By the end of 1955, new plant facilities are estimated to have raised total installed production potential to 1,065 million lbs.

Some of this new capacity is now coming in and the market is not yet fully capable of absorbing the entire new potential supply. This development, then, is co-responsible for the temporary slump in ethylene oxide prices.

Thus, the industry has entered an

era in which competition compels the very greatest emphasis on low production costs. It is noteworthy that all but an estimated 55 million lbs. of the new capacity will be based on the direct oxidation of ethylene.

Thus this method will, for the first time, be ascendant over the classical process for ethylene oxide production via ethylene chlorohydrin. This development is in striking contrast to the emphasis which was lent until about three years ago to the older route to ethylene glycol. Indeed, as recently as 1950, Carbide and Carbon Chemicals Co.'s South Charleston and Texas City plants were the only U. S. ethylene oxide producers using direct oxidation of ethylene. (In addition, U. S. Industrial Chemicals, Inc., has operated an oxidation unit at Baltimore for a limited period during the early forties).

The rise in chlorine price which has taken place since that time is perhaps the most important single factor accounting for the new activity in direct oxidation. Because it is a heavy consumer of chlorine (approx. 2.1 lbs. per pound of oxide), economics of the competitive chlorohydrination process have been severely and adversely affected by the upward trend of this prime raw material which, by contrast, does not enter the direct oxidation process at all.

Of further importance has been the more general availability of low-cost ethylene in adequate concentration. Such a development would naturally tend to tilt the balance in favor of direct oxidation which consumes 1.1-1.2 lbs. ethylene per pound of oxide, while only about 0.9 lbs. ethylene are required per unit of product in the classical process.

The third outstanding factor which shares responsibility for the new activity in direct ethylene oxidation is the development of new knowledge in this field and the evolution of important process improvements which have rendered the method economically more attractive. At least three direct oxidation processes are publicly offered by engineering firms.

The significant shift from chlorohydrination to direct oxidation as the route to ethylene oxide is strikingly illustrated by the line-up of producers in 1953 and 1955, as listed in Table 2.[3]

The basis of the direct ethylene oxidation process goes back to Lefort's work[4] of the late 1920's. There has been no fundamental change to date in catalyst composition—and silver on a suitable carrier is employed today as it was by Lefort. But within this framework there have been very important advances in understanding of the reaction's fundamentals, in catalyst formulation, in control of operating variables, and in engineering aspects of the reactor section as well as of the purification stages. Today's operator is given wider latitude in the choice of raw material purity, and better yields and concentrations may be achieved than were possible in early plants of this type.

Optimum use may be made of specific conditions by proper choice of catalyst and "anticatalyst," by weighing air vs. 95% oxygen as oxidizing agent, by selection of fixed-bed or fluidized catalyst reactor, by fixing the degree of ethylene purification, extent of ethylene recycle, method of ethylene oxide recovery and by setting other design variables which have now been fully explored.

Reaction Considerations, Limits

A slightly exothermic reaction leads to the direct formation of ethylene oxide from ethylene:

$$C_2H_4 + 1/2O_2 \rightarrow C_2H_4O + 29.2 \text{ kcal. } (280^\circ \text{ C.}) \quad (1)$$

This conversion stands in competition with the highly exothermic total combustion of feed hydrocarbons:

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O + 317 \text{ kcal. } (280^\circ \text{ C.}) \quad (2)$$

In addition to these two main reactions, which occur simultaneously, a portion of the product ethylene oxide is consumed by complete oxidation, and a small amount of acetaldehyde is formed. There occurs no other reaction of significance. Except for traces of acetaldehyde, ethylene oxide is therefore the only organic oxidation product found in the reactor gases. Separation need be effected only from associated carbon dioxide, water vapor, nitrogen, and unconverted ethylene plus oxygen, and a fairly simple purification problem thus prevails.

The relative rate of Reactions 1 and 2 is strongly influenced by temperature. The initial rate of CO_2 formation has been shown[5] to be about

Table 1—Estimated Outlets for Ethylene Oxide (Equivalent) During 3 Key Years

	1950		1952		1962	
	million pounds	%	million pounds	%	million pounds	%
Ethylene Glycol (from oxide)	310	68.8	490	72.0	653	58.5
Acrylonitrile	26	5.6	40	5.9	188	16.8
Ethanolamines	25	5.5	40	5.9	75	6.7
Polyglycols, etc.	30	6.7	50	7.4	70	6.3
Non-ionics	30	6.7	30	4.4	60	5.4
Miscellaneous	30	6.7	30	4.4	70	6.3
TOTAL	451		680		1116	

Table 2—Producers of Ethylene Oxide

Company	Plant locations	Estimated Capacity by mid-1953 (Millions of Pounds)	Estimated Capacity by 1955 (Millions of Pounds)
Chlorohydrin Plants:			
Carbide and Carbon	S. Charleston, W. Va.	90	90
Dow	Midland, Mich.	20	20
	Freeport, Texas	130	160
Jefferson	Port Neches, Texas	100	100
Wyandotte	Wyandotte, Mich.	20	20
Mathieson	Doe Run, Ky.	75	100
Total capacity, chlorohydrin process		435	490
Oxidation Plants:			
Carbide and Carbon	S. Charleston, W. Va.	20	20
	Texas City, Texas	150	150
	Whiting, Ind.	70	70
	Institute, W. Va.	70	70
	Seadrift, Texas	...	150
	Torrance, Calif.	...	50
Jefferson	Port Neches, Texas	...	30
Allied	Orange, Texas	...	35
Total capacity, oxidation process		310	575
Total capacity, both processes		745	1,065

95% and 60% of the rate of ethylene oxide formation at 274° C. and 234° C., respectively. Selectivity does not vary significantly with reaction time up to the point of maximum ethylene oxide formation. (This stage is reached when the rate of ethylene oxide consumption by further combustion equals product formation.)

Thus, the useful yield is limited to approximately 50-55% at 274° C., and 60-64% at 234° C. The most valuable contribution toward higher yields is therefore formulation of a catalyst with adequate activity at low temperature, or steps for minimizing the combustion of ethylene oxide once it has been formed.

There is evidence that the two competing main reactions are initiated by similar mechanisms. As a result, their *relative rates* are but little affected by reactants concentration. On the other hand, yield-consuming ethylene oxide combustion has been shown[6] to be very strongly influenced by oxygen content (up to a partial pressure of 100-200 mm. Hg), as well as by ethylene oxide concentration. The ratio of reactants does, therefore, exert significant influence on the *maximum* ethylene oxide formation which can be achieved in a single pass. It also determines the *absolute rates* of all reactions at a given temperature.

From kinetic considerations, it may be concluded that increase in partial pressure of oxygen boosts conversion rates and, up to a point, lowers the maximum ethylene oxide formation which is attainable. Raising ethylene content has the reverse effect.

Elevation in total pressure decreases reaction rates somewhat. It has a slightly beneficial effect on maximum ethylene oxide formation but this advantage is insufficient to warrant superatmospheric operation.

Preparation of Catalyst

Silver catalyst serves in all existing commercial plants for the direct oxidation of ethylene to its oxide. Much leeway is, however, given to the exact formulation of catalyst as regards precipitation of the silver metal, choice of catalyst carrier, and incorporation of promoters.

McKim and Cambron[7] distinguish seven methods covered by the patent literature for the preparation of finely divided silver metal or silver oxide. They determined that the activity of unpromoted silver catalysts, prepared by the precipitation of silver metal or its oxide, or by the thermal decomposition of an organic silver salt, is a function of particle size only, and is independent of the method used for preparation. For their own work, the authors chose thermal decomposition of silver oxalate in the presence of water in an autoclave.

Wan[8] reported good results with silver oxide precipitated by the addition of aqueous sodium hydroxide to a solution of silver nitrate in water. This method has also been used for the preparation of commercial catalyst by I. G. Farbenindustrie. Other commercially used methods involve decomposition of silver carbonate, and the use of finely divided technical silver oxide or silver leaf.

Much importance attaches to the proper choice of catalyst support. The material must have sufficiently high thermal conductivity to prevent local overheating wth resulting sintering of catalyst and excessive appearance of complete combustion. This restriction is believed to be less severe in the operation of fluidized-bed reactors. Alumina in one form or another appears to serve generally as catalyst support in the direct oxidation of ethylene.

The use of pure silver, with or without support, is made unfeasible by rapid loss of activity due to sintering at the required operating temperature. It is therefore common practice to incorporate a promoter which serves to enhance both the stability and activity of the catalyst. Oxides of alkali and alkaline earth metals serve effectively in this function. Further improvement has been shown[7] by the incorporation of stannous oxide into silver-calcium oxalate catalyst, before or after thermal decomposition. According to McKim and Cambron, the optimum amount of calcium salt is between 1 and 10% of the finished catalyst. The preferred concentration of stannous oxide is between 2 and 10% of the silver.

The effect of these promoters on catalytic activity is striking. For example, at a given set of operating conditions, McKim was able to convert only 7.6% ethylene to ethylene oxide at 282° C., over pure supported silver. A temperature as low as 268° C. sufficed for the formation of 14.1% product over a catalyst formulated with 1.3% calcium oxalate in silver, and, also at 268°, useful conversion actually reached 16% upon further addition of 2% stannous oxide to the catalyst.

At 298° C., ethylene oxide formation over pure silver was 9.2%, while a conversion of 23.1% could be obtained in the presence of silver modified by the addition of calcium oxalate and stannous oxide. This increase in activity is achieved at the cost of only a slight drop in selectivity.

Details have become available on catalyst formulations which have found successful commercial application.[9] At least two catalyst preparations are reported to have been used on an industrial scale by Distillers, Ltd., a British corporation. The older of these is prepared by finely grinding leaf silver, and mixing the powder with a paste of gum arabic. The product is thoroughly washed, dried and screened. It is, then, briefly heated to 400° C. and is applied to alumina rods which serve as carrier.

The second reported variant of Distillers' catalyst is produced by mixing silver carbonate with corundum and a small amount of gum arabic in a porcelain ball mill. Alumina rods are immersed into the product, which is then dried at 100-150° C. and finally heated to 400° C. for 30 min.

The catalyst developed by I. G. Farbenindustrie is prepared by precipitating silver oxide from a 10% silver nitrate solution by means of a 10% solution of potassium hydroxide (no chloride or sulfide ion!). The product is filtered and thoroughly washed. The wet filter cake is made into a paste and mixed with pumice particles of 6-mm. diameter, which have been washed with nitric acid and water. The mass is then gently heated for the removal of water and is reduced by a 5-10% hydrogen-in-nitrogen gas stream at 150-200° C. The finished catalyst contains about 350 grams silver per liter.

These catalysts have a life of about one year when operated on gases of satisfactory purity. Reproducibility of results is not very good and the optimum temperature must be determined for each batch. Methods for the regeneration of spent catalysts have not been reported.

Wan[8] precipitates silver hydroxide by the addition of 10% sodium hydroxide solution to 100 grams silver nitrate dissolved in 800 ml. distilled water. 20 ml. of 30% hydrogen peroxide is added to the slurry, which is then settled, decanted and washed. The precipitate is mixed with alumina (400 g.), washed and dried. At this stage, also, 14 g. barium peroxide (promoter) is added. The dried catalyst is treated with a 10% ethylene-90% nitrogen stream at 250-270° C. McBee[10] also adds barium peroxide to promote catalyst activity. In the latter's work, corundum served as carrier with excellent results.

The use of "anticatalysts," especially ethylene dichloride, has been suggested by various patents[11, 12] to suppress the formation of CO_2. Experimental evidence on the efficacy of

such materials is divergent. McBee[10] reports that the addition of small amounts of ethylene dichloride to the feedstream has a very favorable effect on the efficiency of the partial oxidation of ethylene. Addition in excessive amount results in poisoning of the catalyst. Catalysts poisoned in this manner may be regenerated by continuing the reaction at higher temperature in the absence of the "anticatalyst." It is indicated, however, that a catalyst, once poisoned, suffers considerable loss in life expectancy.

Using 99.5% ethylene, McKim and Cambron[7] on the other hand, did not find a favorable effect upon addition of ethylene dichloride. Rapid catalyst deactivation was noted at dichloride concentrations as low as .0001% of the inlet gas volume. The work of these authors suggests that any beneficial effect of ethylene dichloride is related to the presence of paraffins in the feed mixture. Thus, a process developed by the National Council of Canada[13] makes use of this anticatalyst in the direct oxidation of dilute ethylene. It is reported that this process can successfully handle refinery absorber residue gases containing as little as 10% ethylene by suppressing the oxidation of paraffinic hydrocarbons. For reasons of adequate temperature control in the catalyst bed, such a bar to paraffin combustion is, of course, essential if a dilute hydrocarbon is to be converted successfully.

Effect of Process Variables

1—Purity of Raw Materials—The greatest part of the heat of reaction is not due to the formation of ethylene oxide but rather to the complete combustion of hydrocarbon feed. It is therefore important, from an engineering point of view, to give this side reaction as little rein as possible in order not to overtax the heat transfer capacity of the reactor.

The presence of non-ethylenic hydrocarbons is undesirable because their combustion will contribute to the heat evolved without doing any useful work. Beyond that, the presence of paraffins has been shown[7] to have a definitely depressive influence on the selectivity of ethylene oxidation. This effect is very pronounced in the case of propane which, when present in even relatively small amounts, causes a marked decrease in attainable ethylene oxide yield. A similar, though much less marked, effect is occasioned by the presence of methane or ethane.

Ethylene or 95-98% purity is readily produced and is generally economically feasible. Still, there would be obvious advantage to a process capable of utilizing a more dilute ethylene feed. The use of "anticatalysts" in this connection has been discussed above. It has been stated[14] that even without such measures, feed gas containing between 40 and 60% ethylene has been utilized commercially. The economics of permissible degree of dilution are determined by the cost of concentrating ethylene, the value of the dilute stock, and the cost of providing adequate heat removal facilities in the reactor.

The presence of acetylene is exceedingly deleterious to the catalyst and presents, moreover, a serious safety hazard. Substantially complete absence of acetylene must therefore be assured and this may be accomplished by scrubbing the hydrocarbon feed (with acetone, acetonyl acetone, or dimethyl formamide), or by partial hydrogenation to ethylene.

Sulfur must be absent from the reactor feed gases to avoid damage to the catalyst from this source.

2—Choice of Oxidizing Agent—Air serves in all existing commercial installations as oxidizing agent for ethylene. For best yield only a limited conversion per pass may be taken. Because of the great amount of nitrogen ballast only about one-half of the reactor effluent gas may be recycled (after ethylene oxide removal). Lost with the vented stream is nearly one-quarter of the ethylene feed to the system. Beyond that the presence of nitrogen depresses the concentration of oxygen in the reactor feed and thus lowers rate of ethylene oxide formation and boosts the necessary contact time.

A process developed by Shell Development Co., and now offered to the industry by Lummus Co., involves the preferred use of 95% oxygen as oxidizing agent for ethylene. Details on this process have not become available. Reported ethylene consumption is 1.10 lbs. per pound of product, which is the same order of magnitude obtained in air oxidation.

3—Concentration of Reactants—The ratio of air to ethylene has a very pronounced effect on conversion. For good selectivity and conversion it is necessary to use a high air-ethylene ratio. Performance improves rapidly until the ratio of reactants becomes about 7-8 to 1. No improvement in yield can be realized by raising the amount of excess air above this value.

The permissible ethylene concentration is set by the lower explosive limit, which is 3.4 volume percent. The oxidation plant at Zweckel, Germany, was designed for the addition of ethylene in two stages. In this way, ethylene concentration in neither stage exceeds 3%, but the total ethylene volume in once-through operation corresponds to 5% of the recycle-plus-air mixture. The fresh air-ethylene ratio is maintained at 10:1. Further dilution of the feed is brought about by the introduction of recycle gas that is very low in ethylene content.

Work by McKim and Cambron indicates that the rate of reaction is proportional to oxygen concentration.

As in the case of oxidation by air, an asymptotic value for ethylene oxide formation is observed in the system ethylene-oxygen.[8] At constant temperature and space velocity, conversion increases as a nearly linear function of oxygen content until it reaches a substantially constant value at oxygen concentrations above 70%.

Space-time-yield in the system oxygen-ethylene passes through a steep maximum at a molar ratio of approximately 1:1. Ultimate yield is highest at an ethylene concentration between 30 and 40%. This is well within the explosive range, which extends from an ethylene content of 2.9% to 79.9%. Practical operation is therefore confined to feed mixtures containing less than 2.9% of the olefin.

4—Temperature and Contact Time—The influence of operating temperature on reaction performance is interrelated with catalyst activity and contact time.

Selectivity declines rapidly as the catalyst temperature is raised. Conversion to ethylene oxide continues to rise, however, up to the point where combustion of ethylene oxide proceeds more rapidly than its formation. Thus, at any given space velocity, ethylene formation passes through a maximum value as the temperature is boosted.

From considerations of ultimate yield alone, operation at the lowest practicable temperature is desirable. The lower limit is set by uneconomically long contact time requirements, and its actual value is largely a function of catalyst activity. The usefulness of promoters in this connection has already been referred to. It should also be noted that the optimum operating temperature of any silver catalyst increases with its age. In the course of its on-stream life, the temperature must be raised by as much as 20° C. to maintain maximum efficiency.

In air oxidation, optimum reaction temperature with reported catalysts is in the range 260-290° C. and contact

time ranges from 1.3 to 4 sec. Above 300° C., additional complications occur due to sintering of catalyst, especially in the absence of a promoter or modifying agent for silver.

Temperatures as low as 230-240° C. are feasible in the oxidation of ethylene by 95% oxygen.

In keeping with common practice, the foregoing data refer to temperature of the main gas stream. The point, however, is made by Schultze and Theile[20] that catalyst surface temperature is the truly controlling variable in establishing reaction stability and selectivity. Surface hot-spots exceeding gas temperature by as much as 100-300° C. were measured (very high temperature rise resulted in runaway reaction and catalyst deactivation). A maximum in catalyst surface temperature can be clearly discerned at some plane through the catalyst bed near the point of feed gas entry. This high temperature subsides further along the gas path as the rate of total combustion is slowed down by depletion of hydrocarbon and the heat of reaction is dissipated.

It has been found possible to obtain excellent uniformity of temperature throughout the converter bed by providing catalyst at different levels of activity. I.e., catalyst of lowest activity is placed near the point of gas entry where the feed is relatively rich in hydrocarbon. The quality of catalyst is raised along the path of the reaction gases. By this means Schultze and Theile have been able to obtain ethylene oxide yields as high as 69% of theory.

5—Moisture Content—The presence of small amounts of water in the feed gas is without significant effect on the extent of conversion. The presence of 1-2% moisture tends to stabilize the reaction, minimizing the danger of runaway temperatures. Very high steam concentrations result in partial hydrolysis of ethylene oxide in the gas phase. In industrial practice, the gases are generally saturated with water vapor at the temperature of the surroundings.

Fixed-Bed vs. Fluidized Reactor

The controlling feature in successful converter design for direct ethylene oxidation is adequacy of heat removal facilities. Temperature must be held within fairly narrow limits and local hot spots must be rigorously avoided lest they develop into a runaway combustion reaction and cause complete damage to the catalyst.

Reaction 2 is almost wholly responsible for the high heat evolved in this process. If, for example, the process is carried out with 50% efficiency, 14,000 Btu are evolved per pound of ethylene oxide formed, of which the useful Reaction 1 accounts for only 8.1%. At 65% yield, heat evolution is only 8000 Btu per pound of ethylene oxide.

Table 3—Extra Profitability of Direct Oxidation Over the Chlorohydrin Process

Basis: Chlorine at $62.50/U.S. ton
Output—18 million lbs./yr.
Depreciation—10%/yr.
Plant Investment—$1.7 million
No ethylene dichloride credit

Ethylene cost, ¢/lb.	3.1	6.3	9.4
% Yield, Direct Oxidation	Extra Profitability, Direct Oxidation over Chlorohydrination (Million $/yr.)		
50	1.05	0.83	0.60
55	1.12	0.96	0.80
60	1.17	1.07	0.96
65	1.22	1.16	1.10
70	1.25	1.23	1.27

The very high cost of reaction equipment is therefore entirely due to the formation of undesired CO_2. Improvement of reaction efficiency will have the dual advantage of ethylene saving and of appreciable reduction in initial plant cost.

All existing industrial installations involve the use of fixed-bed catalytic converters. Advantage may also be taken of the excellent suitability of fluidized-bed reactors for effective heat transfer, and a process involving this feature has been developed through the pilot plant stage by Atlantic Refining Co. in collaboration with Vulcan Engineering Division of Vulcan Copper & Supply Co.

Two direct oxidation plants which have been recently engineered by Scientific Design Co. for Naphthachimie at Etang-de-Berre, France, and for Allied Chemical and Dye Co. at Orange, Texas, involve the use of fixed-bed reactors. Major factors which have led to adoption of this system in preference to dense-phase fluidized-bed operation have been outlined by Landau[15] as follows:

1—There is a tendency to backmixing in fluidized-bed reactors which may affect yields adversely—especially in large units.

2—Catalyst attrition, life, and recovery problems are particularly serious for a catalyst as expensive as the one in ethylene oxide service.

3—The useful range of flow rates and catalyst particle size is held within relatively narrow limits by the hydrodynamic instability of fluidized-bed systems.

4—Since no catalyst regeneration is involved, many of the specific advantages of fluidization are not realizable.

5—Adequate heat control for oxidation can be provided in fixed-bed units.

6—Cost of the fixed-bed reactor constitutes only a relatively small portion (6-8%) of total capital investment and is not susceptible to major savings.

Equally cogent arguments may be advanced in favor of fluidized-bed design. Corrigan[16] states that Vulcan's converter is designed to minimize the backmixing effect. Certainly an important benefit is the larger latitude to catalyst formulation which is allowed by the absence of local hot-spots and the less stringent requirements of crushing strength which are placed on the catalyst in fluidized-bed converters.

A certain parallel is seen in choice of reactors for the production of phthalic acid anhydride. Here, too, a highly exothermic reaction is carried out in the presence of an expensive catalyst and on a relatively small scale (i.e. "small" when compared to the throughputs of catalytic crackers and reformers in the petroleum refining industry). In this instance, both fixed-bed and fluidized-phase reactors serve in recently erected plants. (Fluidized-bed converters for phthalic anhydride production are operated by Sherwin-Williams Co. and by Imperial Chemical Industries, Ltd.)

Both shell-and-tube and finned-tube reactors may serve for fixed-bed catalytic oxidation of ethylene. Convertors of the former type were designed for the ethylene oxide plant at Zweckel. Here, the catalyst is arranged inside 3055 internally galvanized (or preferably stainless steel) tubes, which are tapered in order to maintain approximately the same gas velocity at all points. The cooling medium (oil or water) enters at the bottom of the reactor through side openings in the jacket which are carefully arranged to maintain uniformity of coolant flow at all points. After traversing the reactor countercurrently to the gas stream, the cooling medium leaves the top of the jacket through outlet openings spaced uniformly along the periphery.

The choice of corrosion-resistant materials is essential. Presence of rust inside the reactor tubes would catalyze the formation of formaldehyde and formic acid and the complete combustion of ethylene.

In Vulcan's fluidized-bed converter, the catalyst is carried inside a number of vertical tubes, operated in parallel. Enough catalyst is used to provide a layer above the tube sheet to ensure

uniform distribution inside the tubes. Distribution of the gas stream is controlled by orifices at the point of entrance, near the bottom of each tube.

Dowtherm serves as heat exchange medium. Its vapor, generated within the reactor, is condensed in an external waste-heat steam boiler.

Product Purification

The product of the oxidation stage contains essentially only dilute ethylene oxide, together with unreacted ethylene, nitrogen, oxygen, carbon dioxide and water. Separation and purification of the product can be effected without great difficulties. Distillers Co., Ltd., adsorbed ethylene oxide on activated charcoal which was periodically regenerated. In order to avoid the formation of glycol, which is removed only with difficulty from the carbon, it is necessary to avoid the presence of alkali in the charcoal and to keep the amount of moisture at a minimum. Polymerization losses in adsorptive recovery may be quite high and range reportedly up to 50%.

The method commonly employed for recovery of ethylene oxide is absorption in water. The scrubbed gases are partly recycled to the primary reactor and partly bled off. In Vulcan's system, a secondary reactor is provided to obtain further yield on a once-through basis from off-gases which are not recycled to the primary stage. A second water scrubber serves for recovery of ethylene oxide formed in the secondary converter.

Only a very dilute solution of ethylene oxide can be obtained by water washing. The absorbate is steam-stripped in a bubble-plate column and the strippings are rectified. Carbon dioxide and inerts are taken overhead. The product itself is withdrawn from the rectifying column as a sidestream. It is stripped for removal of residual traces of carbon dioxide. The bottoms product of this final purifying operation is specification-grade ethylene oxide.

Where ethylene glycol is the desired plant product, hydrolysis and recovery are effected simultaneously. The usual procedure is to absorb ethlyene oxide from the reactor gases in dilute (say 1%) sulfuric acid. Under such conditions, conversion occurs directly to ethylene glycol.

The solution is built up to approximately 20% glycol content. A portion is continuously withdrawn for further treatment. The remainder is mixed with make-up water and acid and is recycled through the absorption system. For the installation at Zweckel, two 35-ft.-high, rubber-lined, Raschig ring-packed absorption towers were provided in series. The absorption takes place at 45 psi.

After withdrawal from the absorption system, the glycol solution is neutralized with caustic soda. It is then concentrated to 90% glycol content in a vacuum evaporator and is desalted.

Final treatment is the removal of water in continuous vacuum stills. The bottoms are separated into ethylene glycol, di-glycol, and tri-glycol by fractionation at 60-70 mm. Hg. Ethylene glycol make is up to 80-85% of the total glycols produced.

Process Performance and Economics

Yields obtainable by the processes available today for direct oxidation of ethylene vary within relatively narrow limits. Reported variations must probably be assigned to the particular set of conditions selected for process analysis rather than to any inherent differences in yield performance.

Illustrative is the Shell process[17] in which ethylene consumption is 1.10 lbs. per pound of ethylene oxide produced. Somewhat similar yields are reported for processes developed by Scientific Design Co. and I. G. Farbenindustrie. As has been noted, the Shell process involves the preferred use of 95% oxygen. Consumption of oxidizing agent is at the rate of 1.8 lbs. per pound of product.

Lummus Co. estimates capital requirements of $5.8 million for a direct oxidation plant capable of producing 37.5 million lbs. per year of ethylene oxide. Of this total, the oxygen plant accounts for $1.25 million. Allied's 35 million lbs. per year ethylene oxide-glycol plant (using the Scientific Design Co. process) bears a reported investment of $5 million,[18] and first cost of a Vulcan fluidized-bed oxidation plant, rated at 40 million lbs. ethylene oxide per year, has been estimated at $4.25 million at 1952 prices.[19]

With ethylene at 4.5¢/lb., the oxide can be produced at costs between 8 and 9¢/lb. This range has been reported for all of the above processes.

The attractiveness of direct oxidation must be evaluated in relation to the chlorohydrin route. Borrows and Caplin[21] estimate that capital investment in a partial oxidation plant is about 50% higher than that of a chlorohydrination unit of like capacity.

A direct oxidation plant becomes particularly attractive at times of high chlorine costs. It is, moreover, not tied to closeness of chlorine supply and to the availability of a market for by-product ethylene dichloride, which are prerequisites for successful operation of a chlorohydrination unit.

Even a relatively small increase in ethylene oxide yield has marked influence on the profitability of the partial oxidation process. The cost advantage of the direct route over the classical method has been reported by Borrows[21] for British plant conditions at different yields and raw materials prices, as given in Table 3.

Each of these figures is affected by $16,000 for each $1.00/ton variation in the price of chlorine. Actual investment may be somewhat higher than indicated above, with corresponding reduction in the cost advantage of the direct oxidation process. Further influence is exerted by the value of ethylene dichloride which is obtained in the chlorohydrination process at the rate of 0.16 lbs. per pound of ethylene oxide.

According to Borrows' study, ethylene oxidation may be carried out profitably at lower plant capacity utilization than is possible in the indirect route.

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Do You Know These Words?

By B. H. Weil
Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

A regular department intended to help administrators and operating men alike keep abreast of technical names and processes in the petrochemical field.

Para-tertiary-Butylbenzoic Acid

Para-tertiary-**Butylbenzoic Acid,** abbreviated to *p*-TBBA for everyday use, is a true petrochemical which has recently arrived at an adult stage of manufacture (plant-scale production). Pronounced (in full) as **"pahr·ah·tur·shih·air·ih·beu·till·ben·zoe·ik ass·id,"** this substance has the formula: $p\text{-}(CH_3)_3C\cdot C_6H_4\cdot COOH$.

Chief among the present uses of this new petrochemical is the upgrading of vegetable oils, through partial replacement. When so employed *p*-TBBA improves the drying time, color, color retention, gloss, and surface hardness of alkyd-resin paints in which such oils are used. Potential uses include the synthesis of esters for use as plasticizers (for vinyl and cellulose plastics); the preparation of corrosion inhibitors, insecticides, and waxes; and the manufacture of metal salts (for grease soaps, vinyl-plastic stabilizers, and thickening agents for paints and hydrocarbons).

Production of *p*-TBBA is by the catalytic oxidation of *para-tertiary*-butyl toluene, $p\text{-}(CH_3)_3C\cdot C_6H_4\cdot CH_3$, which in turn is presumably derived by the alkylation of toluene, $C_6H_5\cdot CH_3$, with isobutylene, $(CH_3)_2CH\cdot CH_2$. As is well known, toluene is a petrochemical that is being extracted or otherwise separated in large quantities from naphtha catalytic reformates, while isobutylene is separated from refinery cracked cases or prepared by the catalytic dehydrogenation of (LPG or LRG) isobutane.

The field of complex "aromatic" hydrocarbons is now being penetrated by petrochemical derivatives, chemicals often available for the first time in abundant supply at commercially attractive prices. One of these petrochemicals is *p*-TBBA.

1,4-Butanediol

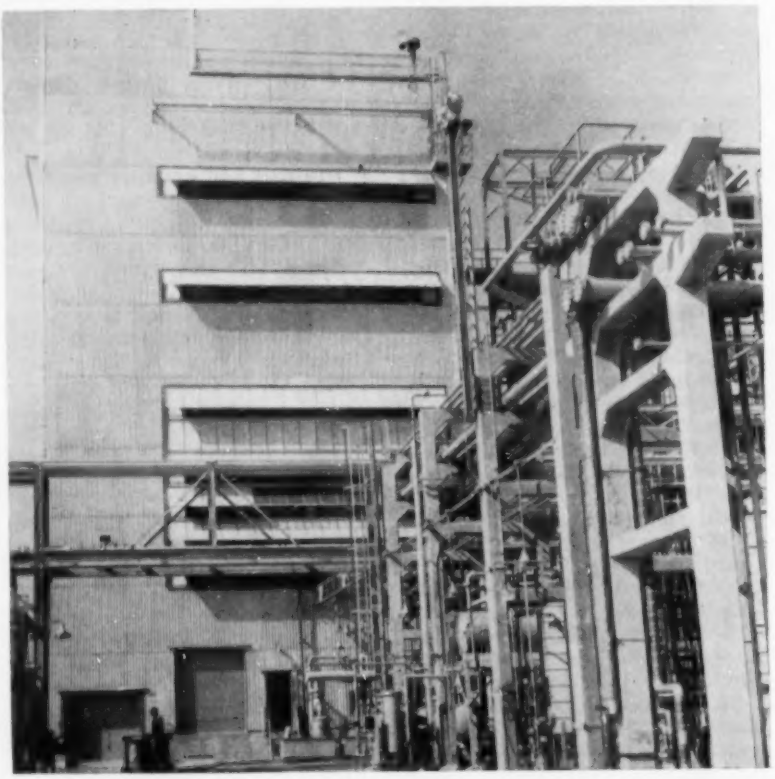
1,4-Butanediol, pronounced **"beu**-taine-**dye**-ole," is a "Reppechemistry" derivative of acetylene and formaldehyde, both of which are modern petrochemicals. It has the formula $HOCH_2CH_2\text{-}CH_2CH_2OH$ (a "diol" contains two OH groups replacing hydrogens); is a colorless liquid with a mild odor; is soluble in water and many organic solvents; weighs about the same as water per gallon; and freezes and boils at 69.6° F and 442.4° F, respectively.

1,4-Butanediol is produced commercially by the reaction of acetylene (HC:CH) with formaldehyde (HCHO) under high temperatures and pressures, followed by catalytic hydrogenation. It was manufactured by the Germans in World War II as an intermediate in the production of butadiene for Buna synthetic rubber, polyurethanes for synthetic fibers (Perlon U), and polyvinylpyrrolidone, a synthetic blood-volume expander. First produced in this country on a pilot-plant scale in 1948, it is now scheduled for plant-scale production by the end of 1955, for use in the synthesis of unique organic solvents, intermediates, copolymerization agents, blood-volume expanders, cosmetics, and perhaps fibers, plasticizers, and polyester resins.

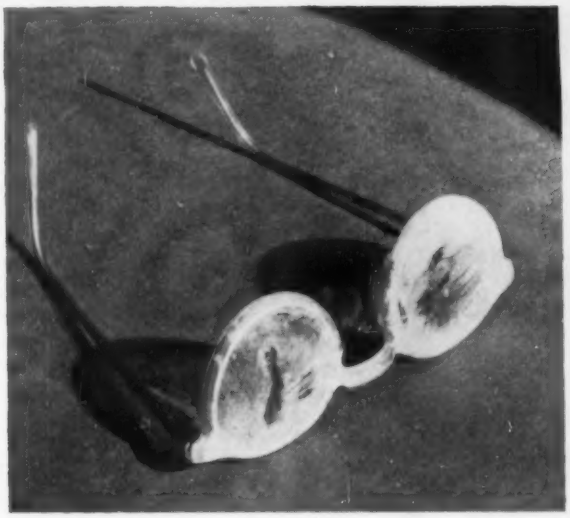
Acetylene, the basic material for this diol, can be produced from natural gas; although coal-based acetylene is being used in the present plant, large-scale manufacture will undoubtedly be based on natural gas. Formaldehyde is produced from methanol, in turn prepared from the incomplete-combustion products of natural gas. Hydrogen can be manufactured by reacting refinery gases or natural gas with steam, or recovered from refinery cracking and reforming operations.

Acetylene derivatives bulk large on the horizon of petrochemicals. 1,4-Butanediol is among the first to reach volume production.

NEWS in VIEWS



PLANT PROTECTS ITSELF—this new epoxy resin plant, said to be the world's largest and brought onstream recently by Shell Chemical Corp. at Houston, Texas, has buildings and other structures coated with paints containing the petroleum-based resins made here.



CORROSIVE-SPATTERED glasses that saved a man's eyes, plus . . .

CONTINUAL SAFETY MEETINGS are ways Houdry developed . . .

A Safety Glass Program That Worked

THE effectiveness of an intensive voluntary safety glass program in the reduction of eye injuries has been strikingly illustrated by the experience of the research and development laboratories of Houdry Process Corp. at Marcus Hook, Penna.

Houdry found in 1952 that eye injuries were comprising a disproportionate share of all accidents, accounting for 10 out of a total of 37 accidents reported in that year. Prior to 1952, eye injuries had been averaging 8 to 10 annually.

By contrast, eye accidents have declined markedly since the inauguration of a safety glass program. For example, only two such accidents occurred in the period from November, 1953, to April, 1954, in comparison to a total of 6 for the same period the previous year.

This improvement resulted after the company's safety committee early in 1953 undertook a comprehensive survey to determine the most effective means for accident reduction. The committee found that, although safety glasses were always available as part of the supply of personal protective equipment, employes used them only when it was considered necessary.

The voluntary program recommended by the committee and initiated in November, 1953, consisted of two major parts: 1) provision of personal safety glasses to all employes, and 2) an intensive education program to insure that the glasses were used.

Standard type safety glasses were chosen, using so-called "Armorplate" lenses with acetate frames. The lenses are made from ophthalmic quality glass under the same standards established for the manufacture of prescription lenses. In addition, they are thicker than conventional glasses and are toughened for high impact resistance.

When employes required prescription lenses, safety glasses were provided with such lenses. At no time were compulsory measures adopted. However, supervisors and members of the safety committee combined in encouraging employes to wear safety glasses at all times in the work shops and the laboratory areas.

This program was supplemented with posters, literature, and a continual program of meetings.

Vivid demonstrations of the effectiveness of safety glasses in a few individual near-tragic accidents also assisted in "selling" Houdry's campaign (note photo of glasses that saved a chemist's eyes when an ampoule of ethyl amine exploded in his hands while it was being cooled).

Other cases have also been reported since the safety glass program got underway. One employe, draining a vessel of liquid which he didn't know had been pressurized, received a forceful splash on his glasses, without which a serious eye injury might have resulted. Another worker, while cutting a head out of a steel drum with a cold chisel, was struck on the frame of his safety glasses by a piece of flying metal.

Harry Turner, chairman of Houdry's safety committee, says, "We have every reason to believe that the safety record will approach closer and closer to the 'no accident' goal as the wearing of safety glasses becomes more and more a regular habit."

Stopping Naphthenic Acid Attack

Problem: What new developments have there been in steels that will resist the attack of naphthenic acids?

Discussion: Naphthenic acid, associated with many crude oils, is quite corrosive at elevated temperatures. Some results of a test, run under conditions conducive to attack by naphthenic acid, are shown in the following table. The specimens were exposed in a column of a vacuum unit handling crude oil containing an undisclosed amount of naphthenic acid at 550° F.: *(Please turn page)*

Material	Corr. Rate inches penet./yr.
Monel	0.0012
Nickel	0.0006
Inconel	0.0007
Type 304 stainless steel	0.024
Type 316 stainless steel	0.0009
Mild steel	0.016
Ni-Resist	0.011
Cast iron	0.010

The good behavior of Monel and nickel should be noted, but their use is not suggested at temperatures above about 600° F., as sulfur attack will undoubtedly occur. Monel is used commercially to resist naphthenic acid attack at temperatures below 500° F. Inconel and Type 316 stainless steel are both highly resistant to corrosion and are the preferred materials for high temperature service. The surprise feature of the test was the poor resistance of the Type 304 stainless steel alloy. This low order of performance has been amply checked and appears to be factual.

The preceding article is based on information developed in a conference in Montreal for representatives of several Canadian oil companies and of International Nickel Co. of Canada Ltd. It was prepared for PETROLEUM PROCESSING by John F. Mason, Jr., corrosion engrg. section, development and research dept., International Nickel Co., New York. A major portion of Mr. Mason's work appeared in an article in the Sept., 1953, issue, pp. 1332-5.

Mislaid Your Pipe?

HAVE you ever had any trouble finding buried metal pipe lines around the refinery? If so, maybe this little "divining rod" idea will help out.

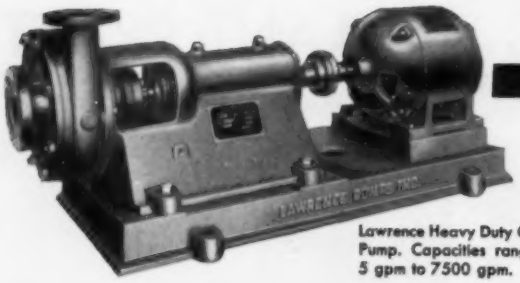
One of our readers out in Wyoming sent this in. He says it will work. We don't have any welding rod handy, so we haven't tried it out. However, we'd be glad to hear from you if you've had any success with it, or if you have some trick of your own. Here's how it works:

Bend two steel welding rods to a 90° angle about six inches from the end. Hold one rod in each hand as you would hold a pistol, with your hands out in front of you, thumbs touching, rods parallel to the ground and to each other. Cup your hands so that NO pressure is applied to the rods.

Then walk slowly toward where you suspect the buried line is located. When your hands are over the line, the left rod will swing to the left and the right rod will swing to the right.

We don't know the maximum depth that this will work, but it has been used on lines that were four feet deep. It will also work on an overhead steel beam, so you have to be careful where you try it out.

Your PLANT PRACTICES EDITOR



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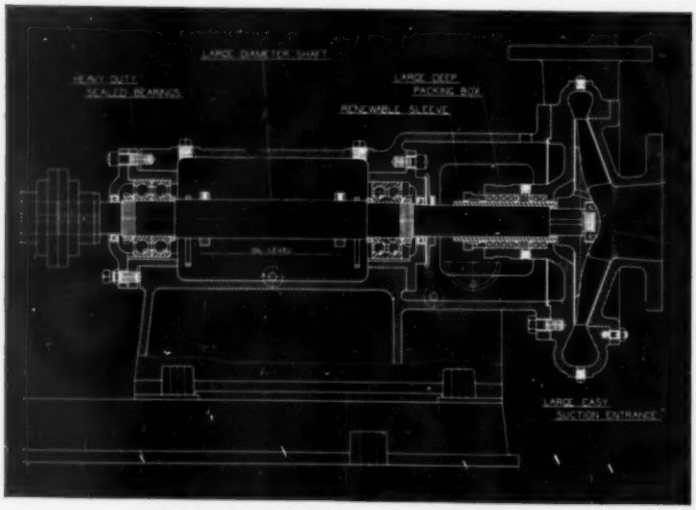
If your problem involves pumping acids, chemicals or slurries write us the pertinent details. No obligation.

Write for Bulletin 203-6 for summary of acid and chemical pump data.



Cross-section of Lawrence Heavy Duty Chemical Pump.

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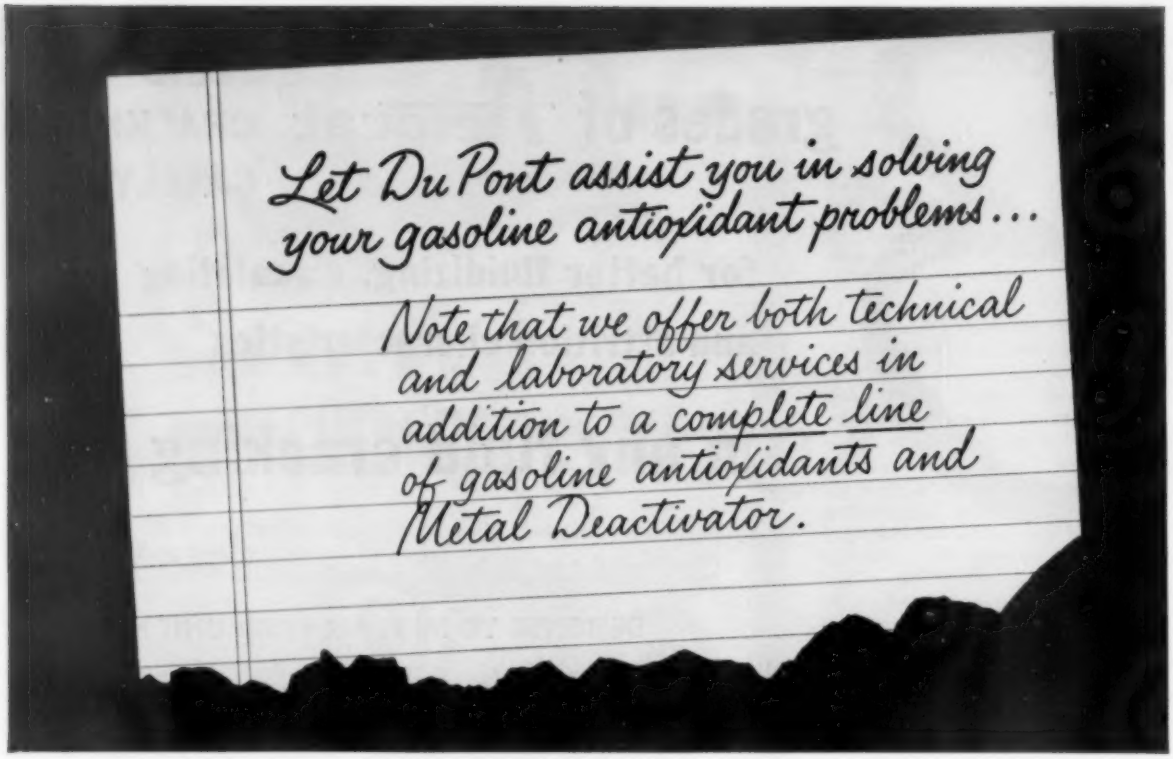
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By Peter J. Gaylor, Patent Attorney, Elizabeth, N. J.

Zirconia Shown Useful as a Treating Adsorbent in Lube Oil Refining

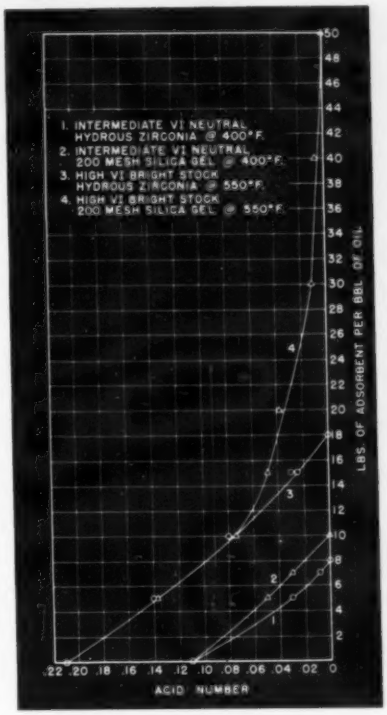
PRECIPITATED hydrous zirconia (zirconium oxide) was found to be peculiarly suitable for refining lubricating oil stocks, particularly for removing acidic substances, such as naphthenic acids, thus lowering the acid number of the product.

In U. S. patent 2,679,471, Pure Oil Co. discloses such a product, which is not a dried gel but a precipitate from a zirconium salt dried only to remove occluded water, leaving only minute quantities of water of hydration. Such a dried zirconia was found to be superior to other adsorbents as a contact agent for producing zero number neutral oils and bright stocks. It adsorbs acids in preference to color bodies, without any substantial effect upon flash, viscosity, sulfur content, pour point, or ash content of the oil.

The precipitated hydrous zirconia is obtainable from Titanium Alloy Mfg. Division of National Lead Co.

Unlike metal oxide gels having intricate interstices which are destroyed on drying, this zirconia is enhanced by drying. Although minute traces of water have little or no effect on the efficiency of the process, the best and most consistent results are obtained in the substantial absence of water. Various filter aids may be admixed during the treatment to facilitate rotary drying, etc. Presence of an inert atmosphere is desirable to protect the lubricating oil stock from oxidation during adsorption, to avoid discoloration of the finished product.

A comparison between dried zirconia and 200-mesh silica gel in adsorbing organic acids from neutrals and bright stocks is shown in the graph. The results show that the zirconia requires a lower ratio of contacting agent to lube oil to yield a given acid number reduction. They also show that zirconia will efficiently reduce the acid number to zero, a property claimed to be not shared by the other adsorbents.


1. INTERMEDIATE VI NEUTRAL HYDROUS ZIRCONIA @ 400°F.
2. INTERMEDIATE VI NEUTRAL 200 MESH SILICA GEL @ 400°F.
3. HIGH VI BRIGHT STOCK HYDROUS ZIRCONIA @ 550°F.
4. HIGH VI BRIGHT STOCK 200 MESH SILICA GEL @ 550°F.
LBS. OF ADSORBENT PER BBL. OF OIL
ACID NUMBER

COMPARISON of hydrous zirconia to silica gel for acid removal in neutrals and bright stocks

Sulfurized Polymer Makes Synthetic Lubricants

IN THE Socony-Vacuum Oil Co. patent 2,681,905, attention has been directed to the recent discovery that certain mono-olefins can be polymerized with sulfur under well-defined conditions to form synthetic lubricants having high viscosity index and other desirable properties. This development was covered in U. S. patent 2,500,164, and involves reacting normal alpha olefins, of 6-14 carbon atoms per molecule, with sulfur at 550-750° F., the amount of sulfur reacted being about 0.15 mol per mol of olefin.

Although such synthetic lubricants are of excellent character, they are obtained in low yields and thus are not economically of any great interest.

In the recent patent, lubricants of excellent quality are obtained by reacting, in a non-oxidizing atmosphere, certain polymers of normal alpha monoolefins, having 6-14 carbon atoms per molecule, with sulfur at 500-750° F. for ½-10 hrs., the quantity of sulfur reacted being 0.1-5 wt.-%. Polymers such as those obtained in patent 2,500,166, may be employed.

Examples given show that a n-decene-l polymer boiling in the range 340-930°F., treated with 12% by weight of sulfur, gave a 61.2% yield of 140 V. I. oil containing 1.78% sulfur.

Hydrocarbon Refining with Heavy Metal Chlorides

Removal of coloring and sludging impurities in gasolines and fuel oils can be effected by use of heavy metal chloride solutions in accordance with the process described in U. S. Patent 2,642,382 issued to Houdry Process Corp.

In one example, an aged fuel oil was shaken at room temperature with a strong solution of ferric chloride (sp. gr. 1.50) admixed with 9 parts of strong calcium chloride solution (sp. gr. 1.36), resulting in a treating mixture containing 235 gms $FeCl_3$ per liter of solution. The solution was shaken for a minute with 20 volumes of the fuel oil, which had a color of 6 (NPA), with resulting formation of black sludge. The oil was separated from the sludge and water-washed, with resulting lightening of the color to 2.75. The treated oil showed excellent storage stability.

Magnesium-Zinc Additive Improves Aircraft Lubes

A SUPERIOR type of airplane engine oil capable of safe and excellent lubrication under high power conditions for periods at least as long as normal engine overhaul periods is claimed to be prepared by use, in a highly refined mineral lubricating oil, of a combination of magnesium and zinc salts of nuclearly alkylated hydroxy aromatic compounds having the hydroxy group attached to the ring. Such an additive may be 0.5-2% of a magnesium alkyl phenolate, where the alkyl substituents on each benzene nucleus of the phenolate contain a total of at least 20 carbon atoms; and 0.25-1.5% of a zinc alkyl phenolate, where the alkyl substituents on each benzene nucleus of the phenolate contain a total of at least 10 carbon atoms.

According to U. S. Patent 2,674,-577 issued to The Texas Co., the conjoint action of these compounds maintains engine cleanliness while at the same time preventing any substantial increase of objectionable combustion chamber deposits over those occurring

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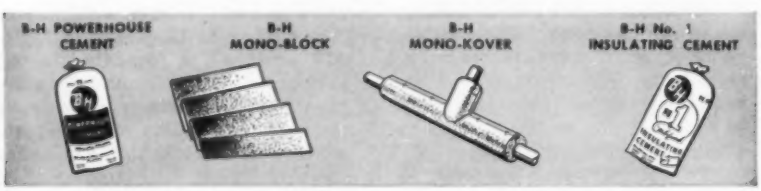

with the lubricating oil alone, whereby preignition and loss of engine power are avoided.

Patents Issued Recently

The following classified listing gives the patent number, patentee, or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazette of the U.S. Patent Office for August 3, 10, 17, and 24, 1954, Vol. 685, Nos. 1-4.

PROCESSES

Refining

2,685,522 (Dunmire) Centrifugal treating of liquid.
2,685,528 (Phillips Petroleum Co.) Re-crystallized aluminum pebbles.
2,685,555 (Phillips Petroleum Co.) Oil extraction from shale.
2,685,556 (Phillips Petroleum Co.) Liquid-liquid solvent extraction and azeotropic distillation.
2,685,557 (Shell Development Co.) Hydrocarbon wax deoiling.
2,685,558 (Standard Oil Development Co.) Neutralizing petroleum lubricating oil treated with sulfuric acid.
2,685,561 (Standard Oil Development Co.) Deashing reduced crude by integrated operation for cat cracking feed.
2,685,578 (California Research Corp.) Separating paraffine with urea.
2,685,605 (The Texas Co.) Separation of olefins from paraffins with silver nitrate-treated silica gel.
2,686,105 (Standard Oil Co. — Ind.) Processing waste caustic containing cresylate by contacting with combustion gas and free oxygen.
2,686,149 (Standard Oil Development Co.) Oil free of alkali metal salts by propane treatment.
2,686,755 (The Texas Co.) Complex formation with urea and thiourea.
2,686,796 (U.S.A.) Treating crude with 10-36% NaOH to emulsify and then separating.
2,687,783 (Universal Oil Products Co.) Separation of gases and vapors in a fluidized adsorption process.
2,687,982 (Standard Oil Development Co.) Combination deasphalting, phenol treating and dewaxing process.
2,687,983 (Socony-Vacuum Oil Co.) Catalytic desulfurization of hydrocarbons with chromia-alumina (sulfided).
2,687,985 (Anglo-Iranian Oil Co.) Removal of vanadium and sodium from petroleum hydrocarbons, using bauxite.
2,687,990 (Socony-Vacuum Oil Co.) Decolorizing oil with cotton adsorbent.

Catalysts

2,685,569 (Davison Chemical Corp.) Silica-magnesia catalyst.
2,686,159 (Standard Oil Co.—Ind.) Removal of entrained metallic mercury from alumina hydrosole.
2,686,161 (Johns-Manville Corp.) Producing spherular siliceous catalyst carrier aggregate granules suitable for fluidization.
2,686,763 (Sun Oil Co.) Regeneration of molybdenum sulfide catalyst.
2,687,381 (Union Oil Co. of Calif.) Method of preparing a cobalt molybdenum impregnated catalyst composite.
2,688,002 (Houdry Process Corp.) Preparing silica-magnesia-alumina gel catalyst.
2,688,003 (Shell Development Co.) Spheroidal silica-alumina catalyst.

Conversions

2,685,498 (M. W. Kellogg Co.) Method for controlling thermal conditions in a gaseous reaction using mass of finely divided solids.
2,685,559 (Standard Oil Development Co.) Gasoline from heavy residual oils using fluidized solids conversion.
2,685,560 (Phillips Petroleum Co.) Pebble heater in conversion process.
2,686,110 (Standard Oil Development Co.) Polymerization reactor.
2,686,111 (Socony-Vacuum Oil Co.) Apparatus for effecting contact of gas with particle form contact material.

 (To obtain more data on advertised products see page 1620)

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Bartlesville, Oklahoma

Patents

2.686.113 (Odell) Promoting chemical reactions between gasiform substances and finely divided solid combustible material.
2.686.150 (Anglo-Iranian Oil Co.) Cracked gasoline from sulfur-containing wax distillate by hydrofining to remove sulfur, separating diesel oil and cat cracking residue.
2.686.151 (Standard Oil Development Co.) Recovery of hydrogen fluoride from regeneration gases of catalytic cracking.
2.686.210 (Standard Oil Development Co.) Control of exothermic reaction in an olefin polymerization process.
2.686.710 (M. W. Kellogg Co.) Catalytic conversion of hydrocarbons using fluidized system.
2.687.343 (Phillips Petroleum Co.) Fluidized bed floating baffle.
2.687.370 (Union Oil Co. of Calif.) Conversion of hydrocarbons with nickel oxide-molybdenum oxide catalyst.
2.687.371 (Socony-Vacuum Oil Co.) Method and apparatus for converting heavy hydrocarbons charged in liquid form, in presence of comminuted material.
2.687.950 (Hydrocarbon Research, Inc.) Gasification of carbonaceous solids to hydrogen-rich gas and fuel gas.
2.687.986 (Standard Oil Development Co.) Visbreaking crude residual fuel oil in low and high severity coils.
2.687.987 (Standard Oil Development Co.) Dehydrogenating hydrocarbons with alumina and compounds of Ca or Mn.
2.687.988 (Standard Oil Development Co.) Regeneration of oily contact solids in suspensoid cracking.
2.687.992 (Universal Oil Products Co.) Conversion of heavy oils in a fluidized coking operation.

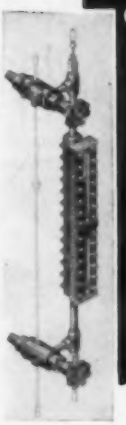
Hydrocarbon Synthesis

2.685.596 (Standard Oil Development Co.) Two-stage hydrocarbon synthesis process.
2.686.195 (Standard Oil Development Co.) Low pressure, once-through hydrocarbon synthesis process.
2.686.196 (Standard Oil Development Co.) Hydrocarbon synthesis and catalyst therefor.
2.686.801 (M. W. Kellogg Co.) Simultaneous production of hydrocarbons and oxygenated compounds.
2.686.819 (M. W. Kellogg Co.) Methane from CO, using a cyclic process.

PRODUCTS

Chemicals

2.685.552 (Shell Development Co.) Dimethyl-1-carbomethoxy-1-propen-2-yl phosphate.
2.685.575 (Borden Co.) Polymerizing ethylenic unsaturates with boron hydride catalyst.
2.685.577 (Standard Oil Co.—Ind.) Polymerizing ethylene to solid with alcohol and peroxide catalyst.
2.685.600 (The Texas Co.) Carboxylating phenols with CO_2.
2.685.605 (Pure Oil Co.) Synthesis of mercaptans.
2.685.941 (Universal Oil Products Co.) Concentrating hydrogen by absorption in hydrocarbon.
2.686.165 (Phillips Petroleum Co.) Emulsion polymerization in presence of synergists.
2.686.171 (Phillips Petroleum Co.) Coagulation of sulfur dioxide resin latices to produce coagulum in crumb or granular form.
2.686.183 (Standard Oil Development Co.) Plasticization of isobutylene-diolefindivinyl aromatic hydrocarbon interpolymers.
2.686.185 (The Texas Co.) Bicyclic heterocyclic compounds.
2.686.194 (M. W. Kellogg Co.) Perfluoroalkyl silicon halide.
2.686.201 (Atlantic Refining Co.) Alkyl-alkanol amine salts of alkylated aryl sulfonic acids.
2.686.204 (Standard Oil Co.—Ind.) Polyketones.
2.686.206 (Standard Oil Co.—Ind.) Oxo process.
2.686.762 (National Research Council — Canada) Conditioning of silver base catalysts for oxidation of ethylene.
2.686.767 & 70 (M. W. Kellogg Co.) Aqueous dispersion of fluorochlorocarbon polymers.
2.686.779 (Phillips Petroleum Co.) Alkali metal sulfates of cellulose, inulin, dextrin and starch.
2.686.802 (California Research Corp.) Surface-active esters of alkene phosphonous acids.
2.686.813 (Shell Development Co.) Oxidizing methylethyl ketone in presence of cuprous oxide to produce diacetyl.
2.686.818 (Sinclair Refining Co.) Extraction of naphthalene from fractions, using methanol.
2.687.380 (Chempatents, Inc.) Regeneration of a silver catalyst useful in preparation of ethylene oxide.
2.687.397 (Shell Development Co.) Resin-forming compositions containing amine salts of sulfonic acids.
2.687.403 (Shell Development Co.) Unsaturated N-substituted amides of tertiary alkyl substituted aromatic acids and polymers thereof.
2.687.439 (Shell Development Co.) Hydrotropic extraction of alcohol.



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(To obtain more data on advertised products see page 1620)

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THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS FOR CONVEYING FLUIDS

Patents

2,687,444 (Phillips Petroleum Co.) Vulcanizable rubber polymer compositions comprising zinc mono alkylbenzene sulfonate as vulcanization retarders.
2,687,951 (Ethyl Corp.) Metal powder containing alkali metal.
2,688,004 (Standard Oil Development Co.) Controlling cure of synthetic polymers.
2,688,005 (Standard Oil Development Co.) Cushion for railroad ties.
2,688,009 (Phillips Petroleum Co.) Solid reaction product of a liquid polymerized diene.
2,688,013 (Continental Oil Co.) Light metal thiocyanate derivatives of phosphor-stabilized aliphatic hydrocarbons.
2,688,041 (Socony-Vacuum Oil Co.) Tellurium oxidation catalyst and method of selective oxidation.
2,686,042 (Imperial Chemical Industries) Carbonylation of mixed olefins.
2,688,044 (Universal Oil Products Co.) Condensation of aromatic compounds with unsaturated organic compounds in presence of mixed catalysts.
2,688,045 (Standard Oil Development Co.) p-Xylene.

Fuels

2,685,502 (The Texas Co.) Diesel fuel containing oil soluble selenium amino compound to improve CN.
2,686,152 (Gulf Research & Development Co.) High quality lump coke from lignitic coals by extraction in presence of hydrogen.
2,686,713 (Socony-Vacuum Oil Co.) Sulfate process tall oil as a rust inhibitor for fuel fractions of mineral oil.
2,686,799 (du Pont Co.) Tetraethyl lead production in presence of polymerizable compounds.
2,687,618 (Socony-Vacuum Oil Co.) Safety storage system for liquefied hydrocarbons.
2,687,991 (Standard Oil Development Co.) Low carbon residue heating oil comprising mixture of sour distillate and cracked distillate.

Lubricants

2,685,347 (Busby) Method of cleaning lubricant chamber and the lubricant therein.
2,685,567 (Shell Development Co.) Lubricant composition containing alkylmercaptoalkyl phosphites.
2,686,155 (Westinghouse Electric Corp.) Molded solid molybdenum disulfide lubricant member.
2,686,156 (Westinghouse Electric Corp.) Preparation of stable molybdenum disulfide lubricants.
2,686,759 (Socony-Vacuum Oil Co.) Lubricating oil containing wax-alkylated styrene-isoprene copolymers as pour depressor.
2,686,760 (Shell Development Co.) Hydraulic fluids and lubricants containing trialkyl phosphate, mineral oil, and phenol-formaldehyde condensate.
2,687,377-8 (California Research Corp.) Lubricant comprising polyalkylene glycol polymeric material and diarylamine or hydroxyaromatic antioxidant.
2,687,984 (Standard Oil Development Co.) Oil noncorrosive to bronze, heated with Pb_3O_4.
2,688,001 (Shell Development Co.) Ash-free low temperature lubricant containing mineral oil with glycerol mono-oleate, lecithin, and alkyl phenol.

Specialties

2,685,523 (Kansas City Testing Laboratory) Asphaltic coating composition and pipeline coated therewith.
2,686,719 (Universal Oil Products Co.) Stabilizing crops with oxidation inhibitor (N,N¹-dialkylene-p-phenylene diamine).
2,686,724 (Universal Oil Products Co.) Stabilizing edible fats and oils with di-substituted aminomethyl dihydroxybenzene.
2,687,376 (Tide Water Associated Oil Co.) Rust preventive composition containing di (N-carboxyalkyl-alkanamide).
2,687,989 (Standard Oil Development Co.) Blend of 2 asphalts.

Miscellaneous

2,685,199 (Standard Oil Development Co.) Apparatus for simulating actual use loading of engines for testing.
2,686,293 (California Research Corp.) Electrical measuring network.
2,686,512 (Deep Rock Oil Corp.) Combustion chamber designs for engines.
2,687,175 (Standard Oil Co.—Ind.) Gelled hydrocarbon (kerosene with aluminum fatty acid soaps and acetylene carbon black), for fracturing formations.
2,687,574 (Pure Oil Co.) Gage for measuring depth of grooves.

EQUIPMENT

Processing, general

2,685,343 (Shell Development Co.) Method and apparatus for deodorizing gases.

(To obtain more data on advertised products see page 1620)

Patents

2.686.046 (Standard Oil Development Co.) Bell cap arrangement.
2.686.110 (Standard Oil Development Co.) Polymerization reactor.
2.686.560 (United Carbon Co.) Fluid hydrocarbon injector.
2.686.562 (Jet-Heet Inc.) Liquid fuel burner system with spray nozzle evacuator.
2.686.563 (Ira J. Shelton) Gas burner head with internal fuel heater and distributor.
2.686.572 (Crop King Co.) Absorption filter device.
2.686.595 (Baker Perkins Inc.) Centrifugal separator.
2.686.957 (A. O. Smith Corp.) Method of manufacturing heat exchanger sections.
2.687.119 (Foster Wheeler Corp.) Fluid heater.
2.687.184 (Fish Engineering Corp.) Variable capacity dust remover scrubber.
2.687.287 (Distillers Co., Ltd.) Fluid liquid contacting device.

Catalytic Reactors

2.686.111 (Socony-Vacuum Oil Co.) Contact material discharge apparatus.
2.686.710 (M. W. Kellogg Co.) Catalytic conversion of hydrocarbons.
2.687.343 (Phillips Petroleum Co.) Fluidized bed floating baffle.
2.687.371 (Socony-Vacuum Oil Co.) Method and apparatus for catalytic hydrocarbon conversion system.
2.687.372 (Socony-Vacuum Oil Co.) Method and apparatus for converting heavy hydrocarbons charged in liquid form.

Instruments

2.685.198 (Howard W. Saul) Fuel efficiency indicator.
2.685.205 (Bailey Meter Co.) Gas sampling apparatus.
2.685.649 (Phillips Petroleum Co.) Infrared analyzer.
2.685.685 (Standard Oil Development Co.) Pipe line alarm.
2.685.796 (Bowser, Inc.) Magnetic-type fluid meter.
2.685.797 (Liquidvision Gauge and Control Corp.) Magnetic liquid-level tank gage.
2.686.424 (Sheffield Corp.) Pneumatic gaging device.
2.686.428 (Nathan Mfg. Corp.) Liquid-level gage.
2.686.429 (Minneapolis-Honeywell Regulator Co.) Fluid pressure gage.
2.686.528 (Backflow Engineering and Equipment Co.) Fluid pressure trip controlled vacuum breaker.
2.686.532 (Carl Gustaf Hard) Balanced pressure and vacuum regulator.
2.686.908 (McGraw Electric Co.) Temperature-indicating device.
2.687.035 (Minter Instrument Corp.) Dewpoint indicator.
2.687.039 (Wilhelm Heidbrink) Moisture content determination and apparatus.
2.687.185 (Irvin G. McChesney) Condensate-sampling system.
2.687.342 (Mine Safety Appliances Co.) Method and apparatus for testing gas.
2.687.457 (F. Bamford and Co., Ltd.) Fluid flow indicator.

Pumps & Compressors

2.685.405 (Edward A. Stalker) Axial flow compressor.
2.686.336 (Maschinenfabrik Paul Leistritz) Kneading pump.
2.686.474 (Oliver Owen Pulley) Electromagnetic pump.
2.686.477 (Adolf Hoschle, Fritz Dietrich) Multistage pump.
2.687.096 (Combustion Engineering Inc.) Seal in centrifugal pump.
2.687.279 (Svenska Turbinfabriks Aktiebolaget Ljungstrom) Elastic fluid turbine or compressor.
2.687.280 (Robert E. B. Sharp) Pump-turbine.

Safety Equipment

2.686.309 (Robert C. Burdick) Welder's helmet.
2.686.310 (Louis Schweikert) Welder's goggles.
2.686.316 (Wayne E. Linn) Safety glove.
2.686.317 (Harold O. Michaelis) Head safety hood.

Valves & Fittings

2.685.426 (Edward Valves, Inc.) Valve body with material flow guide and inclined seat structure.
2.686.498 (Joseph Lucas, Ltd.) Liquid fuel control system.
2.686.533 (Jean Louis Gratzmuller) Diaphragm-type safety valve.
2.686.534 (Carl Oscar Josef Montelius) Nonchattering relief valve.
2.686.626 (Edward J. Slattery) Automatic filling nozzle.
2.687.144 (Arthur W. Rafferty) Valve apparatus for controlling pressure in fluid conduits.
2.687.145 (Clarence F. Carter) Pilot controlled pressure and vacuum operated pneumatic valve.

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Stand and tray are all one unit—no loose parts. Quick easy set-up and take down. Extra-light weight but strong, rigid. Full size vise base—3 benders, ceiling brace screw, pipe rest, lots of tool slots. An unbeatable value—see it at your Supply House!

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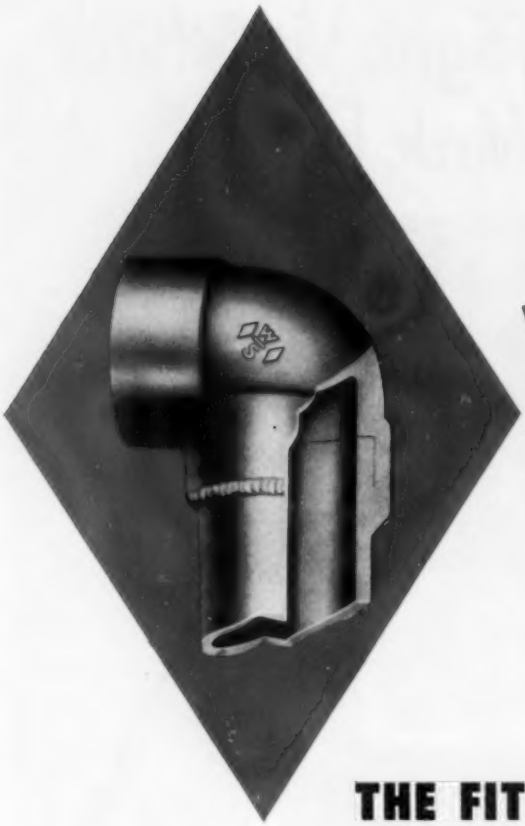
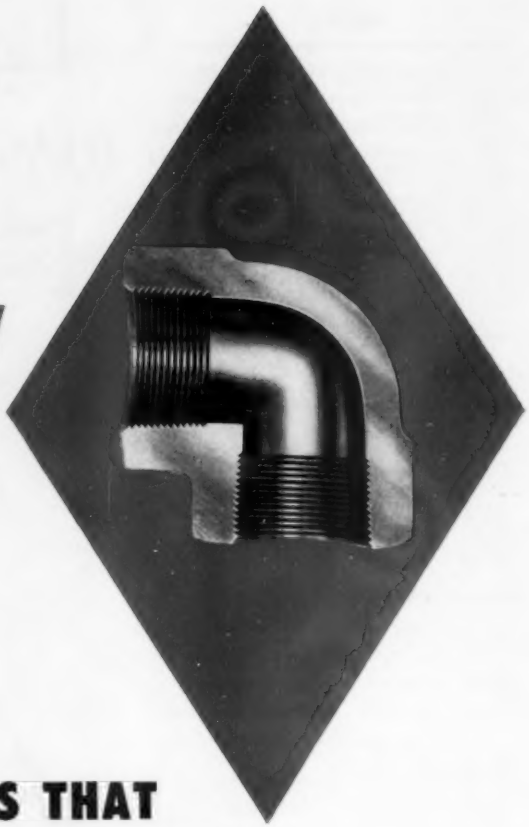


W-S



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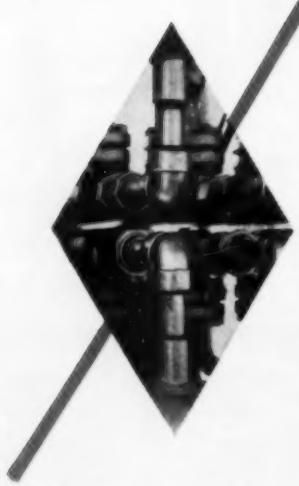

Every elbow, tee and cross in a high pressure piping system is a point of concentrated stress. W-S Forged Steel Fittings take this tough service in stride because they're fabricated and designed to resist pressure, heat, shock and vibration. They're drop forged of highest quality steel to produce a dense, tough, forged-fiber structure that can really take it. And careful heat treatment after forging develops the metallurgical properties of the steel to their fullest.

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W-S high-precision machining and rigorous inspection follow through to give you the fittings that mean stronger, tougher pipe joints. W-S Forged Steel Fittings are available in both Screw-End and Socket-Welding types in carbon, stainless and alloy steels.

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WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, New Jersey

(To obtain more data on advertised products see page 1620)

PERSONALS

Dr. Pullman

Dr. Weith

Mr. Voss

Mr. Miner

Dr. J. C. Pullman, formerly manager of American Cyanamid Co.'s new product development department, has been named manager of technical service of the petrochemicals department. As technical service manager he participates in the commercial development of new uses for acrylonitrile and its derivatives.

Dr. Pullman started his employment with American Cyanamid in 1943 at the company's research laboratories in Stamford, Conn., and was transferred to the new product development department in 1952. He received his B.Sc. in chemistry from Mt. Allison University, Sackville, New Brunswick, and his master's and doctor's degrees from McGill University.

In the meantime, a sales group has been set up in the petrochemicals department to handle most of the products of the company's Fortier plant in New Orleans, La.

Dr. A. J. Weith is assistant sales manager of the new organization, **George C. Voss,** district sales manager with headquarters in New York, and **Frank W. Miner**, district sales manager in Chicago.

Employed by the company in 1947 as a research chemist at the Stamford research laboratories, Dr. Weith became technical representative of the synthetic organic chemicals department of the industrial chemicals division in 1949, and product supervisor of that department in 1951. In 1952 he was made technical director of the manufacturers chemicals department and assistant to the director of sales in what is now the petrochemicals department. Dr. Weith is a graduate of Duke University, where he received his B.A. in 1940, his M.A. in 1941 and his Ph.D. in 1947.

Mr. Voss joined American Cyanamid in 1951 at the Idaho Falls, Ida., plant operated for the Atomic Energy Commission. Here he served in various capacities before being transferred, in 1953, to the intermediate and rubber chemicals department of the organic chemicals division as a technical sales representative. He held this post until his recent appointment to the petrochemicals division. Mr. Voss was graduated from Harvard University with an A.B. degree in the physical sciences.

Beginning with American Cyanamid as a research chemist in 1947, Mr. Miner next worked as a technical assistant in the former Calco chemical division, then as a field representative in the firm's new product development department. In 1951 he was appointed assistant director of the accountability department for the Idaho Falls atomic energy plant, where he remained until 1953, when he transferred to the manufacturers' chemicals department of the industrial chemicals division as a technical sales representative. He became assistant to the department manager in 1954.

Mr. Miner was graduated from Cooper Union with a B.S. in chemical engineering in 1947. Later he attended the graduate school of business of New York University, and received the M. B.A. degree in 1954.

P. N. Gammelgard, formerly general manager of refining of the Pure Oil Co., has become vice-president for refining with direction of the company's network of refineries.

After graduation from Northwestern University in 1934, Mr. Gammelgard joined the company as a trainee in the refining division. He first was in the mechanical department at the Toledo refinery, and later was maintenance engineer and then chief inspector in the refinery inspection department.

After serving in the U.S. Navy, Mr. Gammelgard entered the refining division of the company's headquarters at Chicago. In 1949 he became operations manager and in 1953 general manager of refinery operations.

Dr. Kenneth M. Watson, director of research at Pure Oil's Crystal Lake, Ill., laboratories since he joined the company in 1952, has been promoted to vice-president for research and development. Dr. Watson received his Ph.D. from the University of Wisconsin and served there as an instructor in chemical engineering, an assistant professor and a research professor in the graduate school. He has worked in the petroleum industry for almost 20 years. In 1948 he received the William H. Walker Award of the American Institute of Chemical Engineers.

Jack M. Andrews has been promoted to senior research chemist in the research and development division at Humble Oil & Refining Co.'s Baytown, Texas, refinery. Mr. Andrews received his B.S. degree in chemical engineering at Texas A. & M. College in 1947 and his M.S. in 1948. In his new position he is concerned primarily with investigations in the fields of catalytic cracking and the fluidized solids technique.

George T. Atkins has been promoted to engineering associate in the engineering division at Baytown. He received his B.S. degree in chemical engineering from Washington University, St. Louis, Mo., in 1929. As engineering associate he is concerned with the development of design criteria and with the actual design of certain projects planned for the refinery.

Edward F. Morrill has been made general manager of the new petrochemical division of the Standard Oil Co. (Ohio). In his new post Mr. Morrill has the responsibility for construction of Sohio's new manufacturing plant in the Toledo-Lima area. The plant will produce anhydrous ammonia, urea, nitrogen solutions and nitric acid and is expected to be completed toward the end of 1955.

A graduate of Case Institute of Technology in 1929, Mr. Morrill was employed three years later by Standard of Ohio, starting as a service station employee. He later entered the transportation engineering division and ultimately became assistant manager of transportation operations and president of Sohio Pipe Line Co.

D. J. Smith, formerly president of Pan American Petroleum and Transport Co., has been elected president of the recently reorganized American Oil Co. Mr. Smith has served in executive capacities with Standard Oil Co. (Indiana), and associated companies in Oklahoma, Wyoming, Aruba, N.W.I., and New York. He was president of Pan American Refining Corp. from 1944 until 1947, when he joined Pan American Petroleum and Transport Co.

Executive vice-president of the American Oil Co. is **L. W. Moore,**

TELEDYNE provides a new high standard of accurate, dependable transmission of pressure information from remote, or hazardous locations to central control room. Used with self-balancing potentiometer recorders, controllers and valve systems, TELEDYNE accurately controls pressure of petroleum processes and pipelines. Recorder can be equipped with electrical contacts for signaling approach to, or deviation from desired limits of pressure. TELEDYNE invaluable in experimental work with high pressures. With explosion hazard present, pressure information is telemetered to protected location.

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who was first vice-president of the Pan American Petroleum and Transport Co. until the recent reorganization. Mr. Moore was graduated from Massachusetts Institute of Technology in 1933 and began with Indiana Standard the same year. Transferred to New York in 1935, he served as assistant to the president, manager of research, and manager of manufacturing before being elected president of Pan American Refining Corp. in 1949. He retained this post after his election as first vice-president of the Petroleum and Transport Co. in 1953.

The reorganization changes the American Oil Co. from solely a marketing company to a firm with its own production, refining and transportation facilities. Refineries now operated by the company are at Baltimore, Md., and Savannah, Ga., as well as one currently under construction near Yorktown, Va.

Richard K. Scales, formerly director of automotive products research for the Ethyl Corp., has been appointed general manager of the research laboratories in Detroit, where a recent company realignment has concentrated all research programs undertaken in the field of automotive products.

Dr. George F. Kirby, Jr., has been made general manager of research and engineering on chemical products and manufacturing processes, carried out exclusively at the Baton Rouge, La., plant as a consequence of the recent organizational change. Dr. Kirby was formerly director of research on chemical products.

New assignments have been given to two men connected with the Detroit laboratories. **John B. Macauley** has become director of technical coordination, with the responsibility of coordinating technical relations with the oil and automotive industries. **Earl Bartholomew** has been assigned to serve in an advisory capacity to the laboratories, specializing in the fields of engine, fuel and lubricant relationships.

Leonard Raymond has been promoted from assistant chief to chief automotive engineer of Socony-Vacuum Oil Co. He succeeds **George A. Round,** who has retired from the company after 40 years of service.

Mr. Raymond joined the research and development department at Paulsboro, N.J., in 1945, coming to Socony-Vacuum from Tide Water Associated Oil Co., where he was supervisor of the automotive laboratory. He was transferred to the New York headquarters as chief engineer in 1953.

Mr. Round was employed by the Vacuum Oil Co. in Boston as an automotive engineer in 1914. In 1919 he was moved to the New York offices. When the Vacuum Oil Co. merged with the Standard Oil Co. of New York in 1932, Mr. Round continued as an automotive engineer for Socony-Vacuum. He was promoted to chief automotive engineer in 1939.

Richard H. Findley, senior technologist, catalytic cracking department of Shell Oil Co.'s Houston refinery, has been named manager of the economics and scheduling department at the company's Martinez, Calif., refinery.

Mr. Findley joined Shell in 1943 as a technical assistant at the Wood River, Ill., refinery, after receiving a chemical engineering degree from the Illinois Institute of Technology. He also worked in Shell's New York office.

Howard L. Yowell, head of the motor lubricants and wax section in the Esso Laboratories of the Standard Oil Development Co., is on an exchange assignment as head of the lubricants section of Esso European Laboratories, an affiliate of SOD located in Abingdon, England. This post is held by **Donald H. McLean,** who has taken Mr. Yowell's post in the United States. The exchange arrangement is expected to last one or two years.

R. O. Traylor, manager of the industrial relations division of the Standard Oil Co. (Ind.), has been named manager of the company's new administrative division, formed to replace the old industrial relations office.

L. J. Frodin, superintendent of the old industrial relations unit, has beer appointed assistant manager, and **H. M. Madsen,** administrative assistant to the general manager of manufacturing since 1952, has been named supervisor - procedures in the new division.

C. F. Coffin is now industrial relations manager at the Torrance, Calif., refinery of General Petroleum Corp. He joined the company in 1934 as a truck driver at Vernon. He was promoted to personnel field representative in 1938, and, after returning from service in World War II, became an industrial relations representative at the Torrance refinery.

Mr. Coffin is a graduate of Montana State College.

 (To obtain more data on advertised products see page 1620)

WITH

BENSON ALUMINUM DRUMS

1 **Save on replacement costs!** Strong, lightweight aluminum drums outlast and outperform shipping containers made of other materials . . . offer tremendous savings on replacement costs alone. They do not rust or shatter. They stand up under rough treatment. In addition, aluminum drums have a high salvage value.

2 **Save on labor and material costs!** With the elimination of rust problems go the tremendous labor and material expenses of applying inside enamel and sealer coatings . . . baked-on linings . . . rust-proofing . . . re-tinning . . . galvanizing . . . and other costly formulas and preventatives. You can forget drum maintenance and service and use rust-proof Benson Aluminum drums as they are for years and years.

3 **Save on shipping charges!** To ship a carload of glycerin in heavy-metal drums from Chicago to Philadelphia would cost $558.90 . . . in Benson Aluminum Drums it would cost only $512.95. This saving of $46 means that every eleventh carload is shipped without additional cost. Remember, too, that lightweight Benson Aluminum Drums also reduce handling costs for you and your customers.

4 **Save on your chemical investment!** Your shipments are safe against rust, contamination and spoilage when they go in rust-proof Benson Aluminum Drums. You eliminate the possibility of costly damage suits and claims. Aluminum drums protect both your shipment and your customer good will . . . and save money and worry.

USE BENSON ALUMINUM DRUMS TO SHIP: Acids, alcohols, aniline, fats and oils, liquid fertilizers, formaldahyde, hydrazine, hydrogen peroxide, inflammables and explosives, insecticides and poisons, premium petroleum products, propellants and many specialized products of the process industries.

For further information, contact the Reynolds office listed under "Aluminum" in your classified telephone directory, or write direct to Reynolds Metals Company, 2596 South Third St., Louisville 1, Ky.

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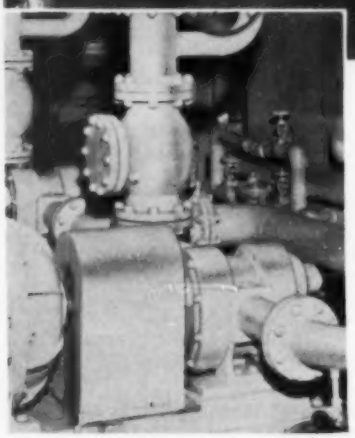
EXCLUSIVE SALES AGENTS FOR BENSON CHEMICAL DRUMS

 (To obtain more data on advertised products see page 1620)

Sier-Bath "Gearex" Pumps Insure *Continuous Operation*

Typical installation in the oil cellar of the Fairless Works Blooming Mill shows a Lube Oil System built by Bowser, Inc., which employs five Sier-Bath Internal Gear & Bearing "Gearex" Pumps.



Two Other *Sier-Bath* "Gearex" Pumps in Lube Service at the Fairless Works

Capacities of Sier-Bath "Gearex" Pumps range from 1 to 550 gpm. Discharge pressure is 250 psi for viscous liquids, 50 psi for water or light oils. "Gearex" Pumps are available in internal or external gear and bearing types for lubricating or non-lubricating liquids, and in horizontal or vertical construction. Steam jacketed bodies and other special adaptations can be supplied.

"LIFE BLOOD" for bearings and gears in steel mill equipment is *lube oil*. Multiple "hearts" of the lube oil systems are the pumps, which ceaselessly feed the equipment from the great oil cellars below. Pump failure can mean loss of production time for pump maintenance or replacement—cause bearing or gear failure, with product losses in the thousands of dollars.

Outstanding for dependability in such critical operations, Sier-Bath "Gearex" Pumps are ideal for continuous process pumping of thick or thin liquids of all varieties—lube oil . . . chemical solutions . . . varnish . . . cellulosics . . . molasses . . . many others.

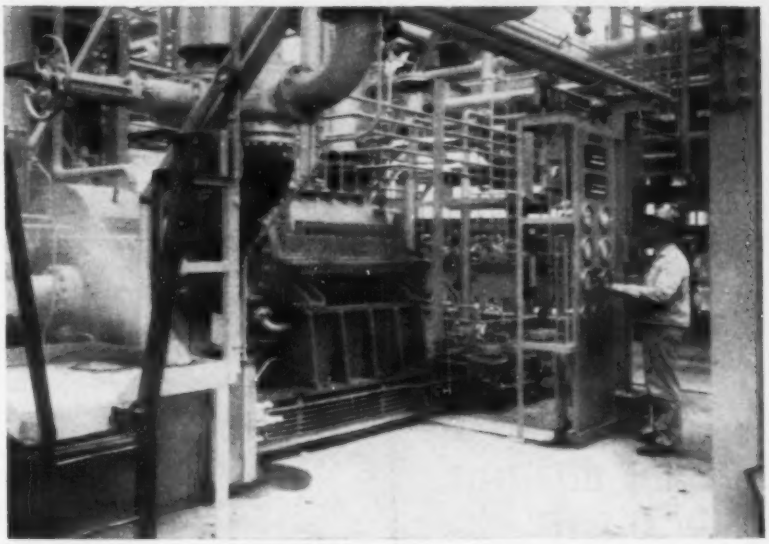
They have *no metallic contact* between rotors or between rotors and casing. Precision-cut timing gears transmit the power between the rotating elements—the rotors are designed *solely* for pumping. The result is higher volumetric efficiency that is sustained longer—minimum chance of failure—longer pump life.

Other advantages for continuous operation are pulseless flow (in lube service oil pressure stays constant at bearings, gears) . . . no vibration . . . cool operation . . . low noise level . . . easy installation and maintenance. For complete information, send for Bulletin G-2. *Sier-Bath Gear & Pump Co., Inc., 9261 Hudson Blvd., North Bergen, N. J.*

Sier-Bath ROTARY PUMPS

SCREW PUMPS
"GEAREX" PUMPS
"HYDREX" PUMPS

Founded 1905 — *Also manufacturers of Precision Gears and Flexible Gear Couplings* — Member A.G.M.A.



FIRST ANHYDROUS AMMONIA CENTRIFUGAL condensing unit to be installed in any U.S. plant is this Worthington Corp. unit built at Phillips Chemical Co.'s Pasadena, Texas, plant, according to the manufacturer. Two Worthington GUR 3R-6 centrifugal ammonia compressors, each driven by a 2500-hp., 9140 rpm. Worthington type "T" non-condensing steam turbine, provide 3000 tons of ammonia refrigeration at 14° F. evaporator and 100° F. condensing temperature.

Cooper Alloy Changes Name

Owing to the gradual increase in the manufacture of special products lines over the years, the Cooper Alloy Foundry Co., Hillside, N. J., has changed its name to Cooper Alloy Corp.

As one consequence company products are now identified with the divisions responsible for their manufacture. The Foundry Products Division turns out stainless steel sand, and shell mold and centrifugal castings. Stainless steel valves, fittings, and accessories are made in the Valve and Fitting Division. Stainless steel rings for military aircraft are provided by the Aircraft Products Division, and production machining of stainless steel components is carried on in the Stainless Engineering and Machine Works Division.

Dr. Wheeler Joins Houdry

Dr. Ahlborn Wheeler has joined the fundamental research division of the Houdry Process Corp., Philadelphia. As an authority on the chemistry of catalysis, Dr. Wheeler will study the catalytic activation of hydrogen while a member of the Houdry staff.

A graduate of Princeton University, Dr. Wheeler has worked for Shell Development Co. and, from 1946 until joining Houdry, for the polychemicals department of the du Pont Co., where he was conducting research on catalytic hydrogenation and reaction rates in catalyst pores.

New Firm to Mold PVC Products

Tube Turns Plastics, Inc., a recently organized company, will utilize a new process of injection molding of unplasticized polyvinyl chloride and similar materials in the fabrication of industrial plastic pipe fittings and a line of custom molded products.

Tube Turns Plastics, located in Louisville, Ky., was established jointly by Tube Turns Division of the National Cylinder Gas Co. and the Jackson & Church Co. The process is one developed by James W. Hendry, a vice-president of Jackson & Church.

Sealol Moves to New Plant

The Sealol Corp. has moved its Providence, R. I., manufacturing operations to a new plant located in Warwick, R. I. The company will continue to maintain its complete manufacturing facilities in Keene, N. H. The new plant, providing 30,000 sq. ft. of floor area for making mechanical seals for the process industry, aircraft, and so on, will be ready about mid-November.

General administrative offices of the company and headquarters for the sales and engineering departments will be housed in the new plant at Warwick.

Organizational Changes at INCO

Four new sections have been created and the assignments of executive personnel changed in the development and research division of the International Nickel Co., Inc.

The new sections and persons in charge of each are: constructional alloy steels, H. V. Beasley; electroplating, Clarence H. Sample; Inco Nickel alloys development, T. E. Kihlgren; and stainless steel and heat-resistant alloys, Dr. V. N. Krivobok.

In addition, W. Z. Friend has succeeded F. L. LaQue as the head of the corrosion engineering section; Dr. T. P. May and H. T. Paterson have been appointed technical manager and operational manager, respectively, of the "Kure Beach" Corrosion Testing Station near Wilmington, N. C.; W. H. Sparr, Jr., has succeeded H. V. Beasley as the head of the technical field section in Pittsburgh, Pa.

GATC Buys Fuller, Subsidiaries

As part of a long-range diversification program General American Transport Corp., Chicago, Ill., has acquired the Fuller Co., of Catasauqua, Pa., manufacturer of pneumatic conveying systems for dry bulk materials handling, as well as vacuum pumps and rotary compressors. The transfer includes the Fuller firm's two wholly owned subsidiaries, Hershey Machine & Foundry Co., of Manheim, Pa., and Separation Process Co., of Catasauqua.

Hainsworth Becomes Fluor VP

Dr. William R. Hainsworth has been appointed vice-president in charge of the research division of the Fluor Corp., Ltd., Los Angeles. Dr. Hainsworth has been with the company since 1952, serving as technical advisor to the executive vice-president. He was formerly vice-president of the Servel, Inc., engineering division and is a past chairman of the Industrial Research Institute.

Dr. Hainsworth

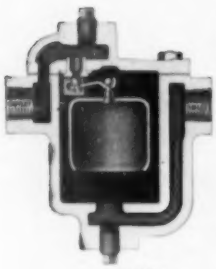
Dr. Hainsworth was graduated from the University of Washington

DOUBLE DRAINAGE

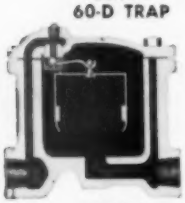
AT LOWER COST WITH

Clark DUO-STEP Traps

FAMOUS DUO-STEP LEVERAGE IS NOW AVAILABLE FOR THE FIRST TIME ON THESE SMALLER SIZED STEAM TRAPS. GET HIGHEST DRAINAGE CAPACITY AT LOWEST COST.



CLARK 60-D TRAP



CLARK 70-D TRAP

Duo-Step is the revolutionary double fulcrum principle that affords maximum leverage to "crack" the valve from the orifice seat, teamed with "Follow-through" power that opens the orifice completely. This double action actually gives you double the drainage capacity of ordinary steam traps.

MODEL 60-D traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400°F. Duo-Step levers and brackets of stainless steel construction. Seats and discs are of Clark-loy. ½" or ¾" horizontal inlet and outlet connections with ¼" test outlet and drain plug. Vertical inlet can be furnished in ½" or ¾" size.

MODEL 70-D traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400°F. All working parts of stainless steel construction. Seats and discs are of Clark-loy. Horizontal inlet and outlet connections located at bottom of trap body for close-to-the-floor installations.

MODEL 70-TD for pressures to 150 P. S. I. and temperatures to 375°F. is available WITH BUILT-IN THERMAL BY-PASS at additional cost.

FOR COMPLETE INFORMATION CONTACT YOUR CLARK REPRESENTATIVE OR WRITE FOR *NEW* DUO-STEP BROCHURE

THE HOME OF DUO-STEP LEVERAGE

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MANUFACTURING COMPANY

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Distributors and Representatives in all major cities

in 1917 with a B.S. degree in chemical engineering. He received his M.S. from California Institute of Technology in 1919, and his doctorate in physical chemistry from Massachusetts Institute of Technology in 1921.

Personnel Changes

National Research Corp.—David Preis to sales engineer in northern New Jersey, New York, and Connecticut's Fairfield County; William F. Bierds, Jr., to sales engineer in southern New Jersey and the central and south Atlantic states. Both men work for the company's sales subsidiary, Naresco Equipment Corp.

General Electric Co.—Michael D. Barnett to sales representative for midwestern district of the Carboloy department.

Lunkenheimer Co. — Marvin L. Steinbuch to chief metallurgist and research director, succeeding John W. Bolton, who has retired after 27 years as director.

Kaiser Steel Corp.—Robert W. Bowles to manager of specialty steel sales.

Rockwell Manufacturing Co. — Thomas O. Carson, from manager of the company's international division to assistant product manager of the Nordstrom Valves Division.

Catalytic Construction Co.—George F. Klein, Jr., to manager of the process engineering department.

Carbide and Carbon Chemicals Co. —R. L. Duncan to eastern division sales manager, with headquarters in New York; J. B. Harlow to district sales manager of the Detroit district; G. E. Bernard to district sales manager of the Atlanta, Ga., district.

Pennsylvania Salt Mfg. Co.—Michael Kuzma to the staff of the corrosion engineering department.

Babcock & Wilcox Co.—G. H. Weight to southwest district sales manager of the Tubular Products Division.

Bailey Meter Co.—F. D. Krusemark to resident engineer, with headquarters in Dallas, Texas.

Beaver Pipe Tools, Inc.—Charles T. Everett to executive vice-president and general manager, succeeding W. A. Phillis, who is scheduled to retire in the near future.

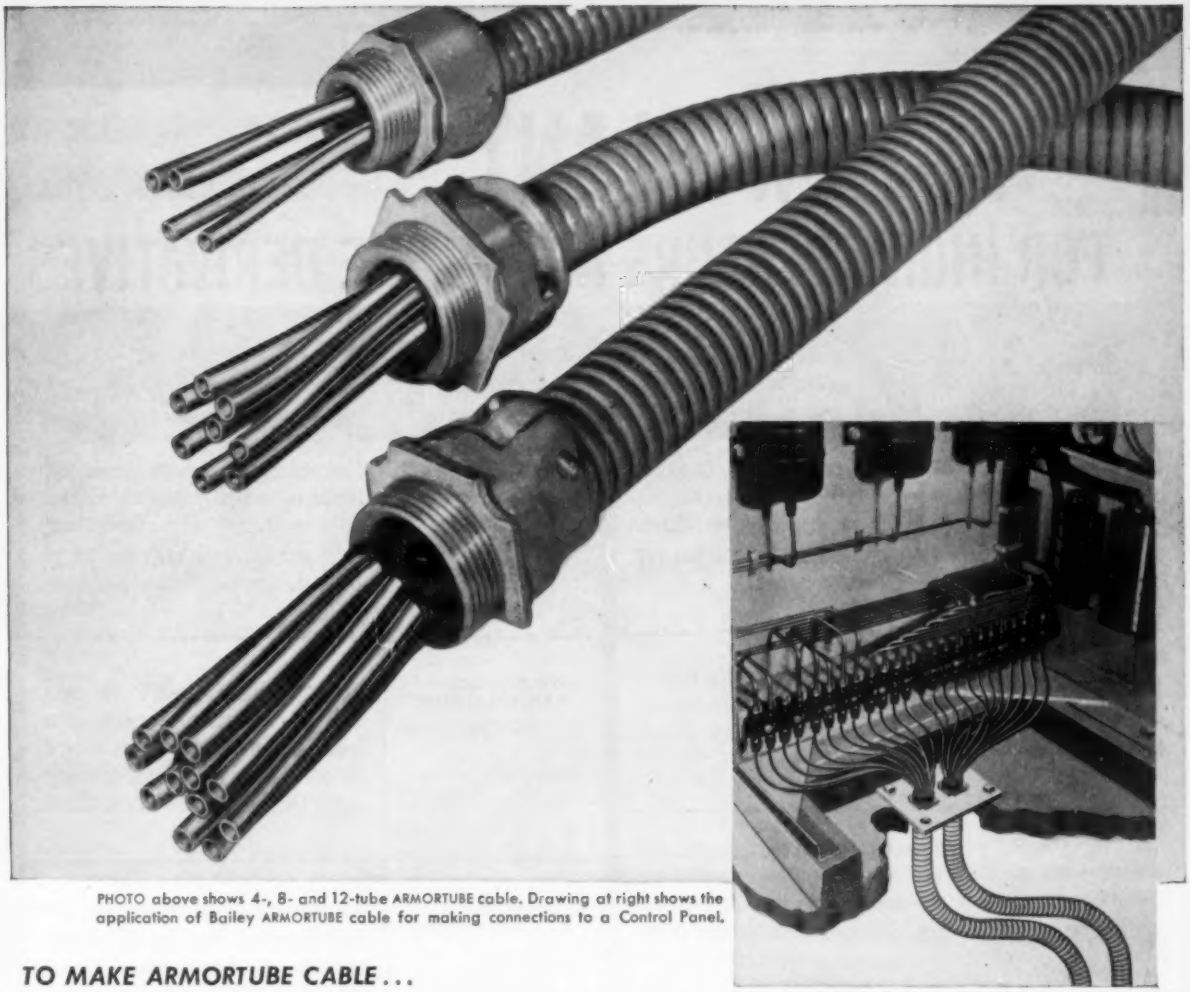

PHOTO above shows 4-, 8- and 12-tube ARMORTUBE cable. Drawing at right shows the application of Bailey ARMORTUBE cable for making connections to a Control Panel.

TO MAKE ARMORTUBE CABLE . . .

Bailey Meter Company turns to Anaconda for long lengths of ¼" O. D. copper tubes

Bailey Meter Co., Cleveland, Ohio, calls its ARMORTUBE Flexible Protected Tube Cable, "the modern shortcut to simpler, safer, more economical air and hydraulic circuits."

As shown above, this cable is available in bundles of four, eight or twelve ¼" O.D. copper tubes. A continuous, heavy galvanized steel strip protects the tube bundle.

Here's why Bailey turned to Anaconda as the logical source of supply for these ¼" O.D. copper tubes.

LONG LENGTHS

Because ARMORTUBE cable is shipped in random lengths of about 500 feet, Bailey needed long lengths of copper tube. Anaconda makes copper tube up to 2,400 feet long, depending on the diameter.

CLEAN INTERIORS

These tubes had to be free from dust, dirt or metal chips which might otherwise interfere with the operation of delicate air and hydraulic circuits. Anaconda takes special care to see that inside surfaces of ANACONDA Copper Tubes are clean, smooth and bright. Tube ends are sealed to keep out moisture and foreign matter during storage.

FLEXIBLE

Tubes had to be flexible enough to bend around corners and obstacles. ANACONDA Copper Tubes are uniformly soft . . . highly flexible. And they are accurate in size and shape.

ANACONDA Dehydrated Copper Tubes are made in all standard sizes up to and including ⅞" O.D. Usually furnished in 25-, 50- and 100-foot coils, they are also available in longer lengths on spools and reels where required.

Our Technical Department will be happy to lend a hand on any problem involving the use of copper tubes. A letter outlining your problem will bring a prompt answer. Write to: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

54138

ANACONDA®

COPPER TUBES

(To obtain more data on advertised products see page 1620)

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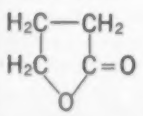
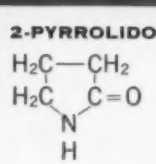
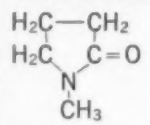
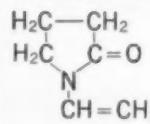
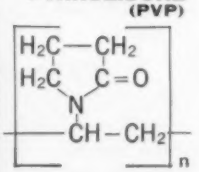
FOR HIGH PRESSURE ACETYLENE DERIVATIVES

to be on stream by the end of 1955

the following products are among those which will be available in commercial quantities

PROPARGYL ALCOHOL $HC{\equiv}CCH_2OH$	Three centers of reactivity. Chemical intermediate for pharmaceuticals, agricultural chemicals, etc. Corrosion inhibitor and stabilizer for halogenated compounds.
PROPARGYL HALIDES $HC{\equiv}CCH_2X$	Three centers of reactivity. Chemical intermediate for terpenes and pharmaceuticals, etc. Agricultural uses as soil fumigant, etc.
2-BUTYNE-1,4-DIOL $HOCH_2C{\equiv}CCH_2OH$	Reacts as a glycol and di-substituted acetylene. Chemical intermediate for solvents, plasticizers, plastics, etc. Corrosion inhibitor and stabilizer for halogenated compounds.
1,4-BUTANE-DIOL $HOCH_2CH_2CH_2CH_2OH$	Reacts as dihydric alcohol. Chemical intermediate for polyesters, polyurethanes, polyamides and cyclic compounds. For use in plasticizers, resins, fibers. Solvent. Humectant.
BUTYRO-LACTONE 	Powerful organic solvent for polyacrylonitrile, cellulose acetate, polystyrene, etc. Selective solvent for acetylene in natural gas. Chemical intermediate for aliphatic and cyclic compounds.
2-PYRROLIDONE 	Polymerizes to high molecular weight, linear, nylon-type, polyamide condensation product. Gives γ-aminobutyric acid and derivatives, also N-acyl lactams.
N-METHYL-2-PYRROLIDONE 	Powerful organic solvent for acrylonitrile polymers and copolymers, cellulose triacetate, etc. Selective solvent for acetylene in natural gas. Spinning agent for polyvinyl chloride solution.
N-VINYL-2-PYRROLIDONE 	Will copolymerize with almost all vinyl monomers. Permits modification of many properties in existing homopolymers. Gives control of hydrophobic and hydrophilic properties of products.
POLYVINYL-PYRROLIDONE (PVP) 	Binder, stabilizer, detoxifier, protective colloid, thickener, film former. Physiologically compatible. Wide solubility range. For use in pharmaceuticals, cosmetics, foods, detergents, dye stripping, synthetic fiber additive, size component, lithography, agricultural chemicals, etc.

Until the new plant at Calvert City, Kentucky, is completed, these products are available in quantities up to tank cars from the GAF pilot plant and semi-works at Linden, N. J.

For technical information, price schedules and samples write to:

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COMMERCIAL DEVELOPMENT DEPARTMENT
435 HUDSON STREET, NEW YORK 14, N. Y.

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From Research to Reality

Two Engineering Groups Inaugurate Annual Lubrication Conferences

Under the joint sponsorship of the American Society of Mechanical Engineers and the American Society of Lubrication Engineers the First Annual Lubrication Conference will be held October 18 to 20 in the Lord Baltimore Hotel, Baltimore, Md.

Technical sessions are to be held on October 18 and 19, committee meetings on the 20th. Topics to be heard at the session on Monday, the 18th, are: Hydrostatic Bearings, Hydrodynamic Bearing Analysis, and, in the evening, Bearing Instability. Tuesday's subjects include: Rolling Element Bearings and Cams, and Friction and Lubricants.

Papers to be read in the last-named session are as follows:

"Friction in a Close-Contact System," by Walter Claypoole, Columbia University.

"The Statistical Nature of Friction," by E. Rabinowicz and B. G. Rightmire, both of Massachusetts Institute of Technology, C. E. Tedholm, San Francisco Naval Shipyard, and R. E. Williams, Curtis Bay Coast Guard Yard.

"An Analysis of Recent Data on the Effects of Temperature and Pressure on the Viscosity of Lubricants, I—Parafinnic and Napthenic Base Oils," by R. B. Dow, Navy Dept.

"Some Experiments on the Flow of Oil and Grease Through Tubes of Circular Cross Section," by H. E. Mahncke and W. Tabor, Westinghouse Research Labs.

Committees of the ASME to meet on Wednesday include the research committee on lubrication (all day), rolling element bearings, fluid film bearings, boundary lubrication and bearing materials, lubricants, and the research group. ASLE groups scheduling meetings are the board of directors, the national program committee, editorial committee, and the general technical committee.

Registration for the sessions is $5, payable in advance, and forms may be obtained from Richard Rimbach, Electronic Computer Clinic, 845 Ridge Ave., Pittsburgh 12, Pa. No registration will be accepted from individuals employed by computer manufacturers.

Assn. Meetings Scheduled During Chemical Exposition

The Eighth National Chemical Exposition, which is sponsored by the Chicago Section of the American Chemical Society and is to be held from October 12 to 15 at the Chicago Coliseum, also will be the occasion of a number of other association meetings.

During the four days of the exposition the Manufacturing Chemists' Association will present a symposium on packaging, transportation and labeling, and the Chemical Market Research Association will offer a symposium on exposition marketing. Technical programs also will be given by the Society of the Chemical Industry and the Purchasing Agents' Association.

API Evaporation Group Plans Meeting in N. Y.

A meeting of the entire committee on evaporation loss of the American Petroleum Institute is scheduled for October 15 in the Esso Standard Oil Building in New York City. During the two days prior to the meeting of the full committee the subcommittees will hold separate sessions. Subcommittees are on "Methods of Testing," under the chairmanship of H. M. Hart, Standard Oil Co. (Ind.); "Correlations," A. B. Stevens, General Petroleum Co.; "Field Test Program Developments," H. C. Packard, Shell Oil Co.; and "Program and Publications," E. L. Hoffman, Socony-Vacuum Oil Co.

The committee is attempting to find ways of evaluating and reducing losses from evaporation of crude oil and petroleum products.

First Automation Exposition To Include Computer Clinic

An electronic computer clinic will be held in conjunction with the First International Automation Exposition at the 244th Regiment Armory, 14th St. between 6th and 7th Avenues, New York City, from November 30 to December 2. The exposition itself begins November 29. The clinic features lectures and demonstrations of electronic computers, digital and analog, and information about typical applications of the different computers.

The sessions will be repeated up to a maximum of nine times so that attendance can be limited in size.

South Texas AIChE Group To Hold One-Day Meeting

A symposium on engine deposits is among the offerings of the forthcoming annual meeting of the South Texas Section of the American Institute of Chemical Engineers. The one-day meeting is to be held October 22 at the Galvez Hotel, Galveston, Texas.

In addition to a discussion of problems related to engine deposits the session will feature a symposium on trends in the Gulf Coast chemical industry, in which the general petrochemical outlook for that area will receive special attention, a general session, and a student session.

Oil Man's Calendar

OCTOBER

Eighth National Chemical Exposition, by the Chicago Section, American Chemical Society, Coliseum, Chicago, Ill., October 12-15.

American Institute of Chemical Engineers, New York Section, symposium on new developments in the petroleum and chemical industries and cost estimation, Hotel Statler, New York City, October 13.

First Lubrication Conference, by the American Society of Mechanical Engineers and the American Society of Electrical Engineers, Lord Baltimore Hotel, Baltimore, Md., October 18-20.

American Institute of Chemical Engineers, South Texas Section, Galvez Hotel, Galveston, October 22.

Association of Consulting Chemists and Chemical Engineers, "open door" annual dinner meeting, 5:00 p.m., Hotel Belmont Plaza, New York City, October 26.

Natural Gasoline Assn. of America, southern regional meeting, Blackstone Hotel, Tyler, Texas, October 29.

NOVEMBER

American Petroleum Institute, 34th annual meeting, Conrad Hilton Hotel and Palmer House, Chicago, Nov. 8-11.

Electronic Computer Clinic, 244th Regiment Armory, New York City, November 30-December 2.

DECEMBER

American Institute of Chemical Engineers, annual meeting, New York City, Dec. 12-15.

JANUARY

Symposium on Hydrocarbon Chemistry, Southeastern Texas Section, American Chemical Society, Houston, Texas, January 27-28, 1955.

Information Offered in the Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

ACTIVATED ALUMINA, gel-type, samples and information; Alcoa Chemicals. See adv't. pp. 1560-1561.

ADDITIVE, furnace oil, rust-inhibiting, samples and product data; Oronite Chemical Co. See adv't. p. 1516.

AIR DRYING equipment, descriptive booklet; Pittsburgh Lectrodryer Corp. See adv't. p. 1551.

BLENDING EQUIPMENT, automatic compounding, brochure SM-2055; Proportioneers, Inc. See adv't. Cover 2.

CATALYST, for fluid cracking, "Aerocat", data sheet; American Cyanamid Co. See adv't. p. 1601.

CLAD STEEL equipment, full color movie; Lukens Clad Steels. See adv't. p. 1586.

CONDENSER TUBES, various metals, technical books available; Wolverine Tube. See adv't. pp. 1528-1529.

CORROSION INHIBITOR, "Polyrad", a filming amine inhibitor, brochure; Hercules Powder Co. See adv't. p. 1556.

FIRE PROTECTION, "Aer-O-Foam", industrial installations, booklet; National Foam System, Inc. See p. 1522.

FITTINGS, welding flanges, alloy steel, bulletin K-1; Key Co. See adv't. p. 1565.

FLEXIBLE JOINTS, for structural use, ball and socket, information; Barco Mfg. Co. See adv't. p. 1606.

FLOATING ROOFS, double pontoon, manual WP-14; General American Transportation Corp. See adv't. p. 1623.

FLUID COOLERS, bulletin DS-395; The Trane Co. See adv't. p. 1562.

GASKETS, "Teflon", various sizes and types, catalog TG-953; U. S. Gasket Co. See adv't. p. 1638.

HEAT EXCHANGERS, evaporative cooling, bulletins 120 and 124; Niagara Blower Co. See adv't. p. 1629.

INSTRUMENT PANELS and cubicles, bulletin 143; Falstrom Co. See adv't. p. 1640.

INSULATION, industrial, 4 data books; Philip Carey Mfg. Co. See adv't. p. 1531.

INSULATION, blocks and cement, bulletin; Baldwin-Hill Co. See adv't. p. 1604.

JACKETED PIPE for uniform temperature and batching problems, bulletins J-50 and F1-49; Hetherington and Berner, Inc. See adv't. p. 1630.

LEVEL CONTROL for hot or cold liquids, information; Jerguson Gage & Valve Co. See adv't. p. 1605.

LIQUID LEVEL CONTROL and indication, bulletin F-3; Fisher Governor Co. See adv't. p. 1644.

LIQUID LEVEL tank gage, electronic, information available; Gilbert & Barker Mfg. Co. See adv't. pp. 1540-1541.

MIST ELIMINATORS, wire mesh type, catalog on request; Metal Textile Corp. See adv't. p. 1564.

MIXERS, side and top entering, nine catalogs; Mixing Equipment Co. See adv't. p. 1566.

OXYGEN ANALYZERS, for continuous process stream measurements, literature; Arnold O. Beckman, Inc. See adv't. p. 1511.

PAINT, aluminum, booklet; Alcoa Aluminum. See adv't. p. 1643.

PETROCHEMICAL PLANT DIRECTORY, sent on request; PETROLEUM PROCESSING. See adv't. p. 1553.

PIPE, valves and fittings, "Saran Lined", corrosion resistant, catalog; Saran Lined Pipe Co. See adv't. p. 1634.

PRESSURE TRANSMITTER, "Teledyne" strain gage, literature; Taber Instrument Corp. See adv't. p. 1610.

PROCESS CONTROL, infrared, for stream analysis, literature; Perkin-Elmer Corp. See adv't. p. 1509.

PUMPS, horizontal, for acids and chemicals, bulletin 203-6; Lawrence Pumps, Inc. See adv't. p. 1600.

PUMPS, rotary, for many applications, bulletin G-2; Sier-Bath Gear & Pump Co., Inc. See adv't. p. 1612.

PUMPS, stuffingboxless, many types, bulletin 107; Bingham Pump Co. See adv't. pp. 1548-1549.

REFORMING, catalytic, brochure; Atlantic Refining Co. See adv't. p. 1542.

REFORMING, catalytic, "Houdriforming", brochure; Houdry Process Corp. See adv't. p. 1628.

STEAM TRAPS, smaller sized with Duostep leverage, brochure; Clark Mfg. Co. See adv't. p. 1614.

STEAM TRAPS, various types, catalog J; Armstrong Machine Works. See adv't. p. 1526.

SWIVEL JOINTS, expansion type, ball bearing, catalog 53-C; Chicksan Co. See adv't. p. 1525.

TANK HEATERS, vertical mounting, bulletin 541; Brown Fintube Co. See adv't. 1633.

TOWER CLEANING, with detergents, booklet; Oakite Products, Inc. See adv't. p. 1642.

TUBE EXPANDERS, for rolling various types of tubes, bulletin 71; Gustav Wiedeke Co. See adv't. p. 1639.

TUBING, "Croloy", technical data card 102 gives creep stress data; Babcock & Wilcox Co. See adv't. p. 1648.

TUBING, various steel alloys, literature; Globe Steel Tubes Co. See adv't. p. 1510.

TURBINES, constant pressure, catalog 500; Dean-Hill Pump Co. See adv't. p. 1538.

VALVE POSITIONER for dampers and slide valves, bulletin 1-86; Askania Regulator Co. See adv't. p. 1632.

VALVES, complete information in bulletin 109-A; Hammel-Dahl Co. See adv't. p. 1534.

VALVES, control, air motor driven, catalog LB-1; Conoflow Corp. See adv't. p. 1563.

VALVES, plug, reference book 39-3; Homestead Valve Mfg. Co. See adv't. p. 1624.

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PETROHOL 95
PETROHOL 99
JAYSOL
Secondary Butyl Alcohol
Secondary Butyl Acetate
Isopropyl Acetate
Acetone
Methyl Ethyl Ketone
Ethyl Ether
Isopropyl Ether
Dicyclopentadiene
Napththenic Acids
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol

CHEMICAL

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PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
Dicyclopentadiene
Isoprene
Butadiene
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(To obtain more data on advertised products see page 1620)

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FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

•

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

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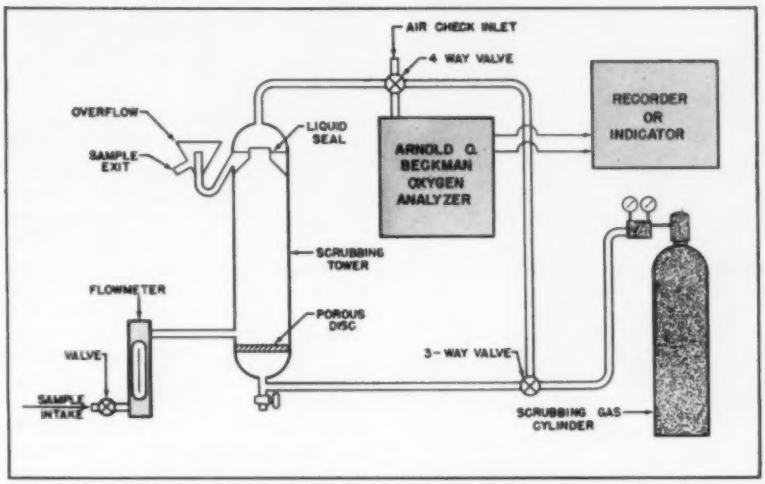
WHAT'S NEW . . .



New Analyzer for Dissolved Oxygen

Continuous measurement of dissolved oxygen in waste, waste disposal, sewage and water treatment plants, manufacture of petroleum products, solvents, chemicals and other operations is possible with the Model 1A3B "Dissolved Oxygen Analyzer." The analyzer measures the oxygen in dissolved gases scrubbed from the liquid being analyzed. It may be installed with any standard potentiometer recorder or indicator, and is designed to read percent saturation or parts per million oxygen. Arnold O. Beckman, Inc., 1020 Mission St., South Pasadena, Calif.

Circle No. **1** *on Reply Card*

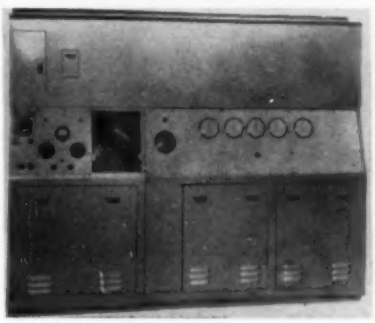
New Solution Ceramics Form Corrosion-Proof Coatings

. . . which are heat resistant and adhere to surfaces so that other coatings can be anchored to them. The coatings, made of refractory metal oxides and other materials, are not brittle and are applied from solutions. Almost any clean solid surface at a few hundred degrees F. will hold films from a few millionths up to 0.01 in. Developed at the Armour Research Foundation, the process will be made available to industrial firms through license agreements. Armour Research Foundation of Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

Circle No. **2** *on Reply Card*

For More Information

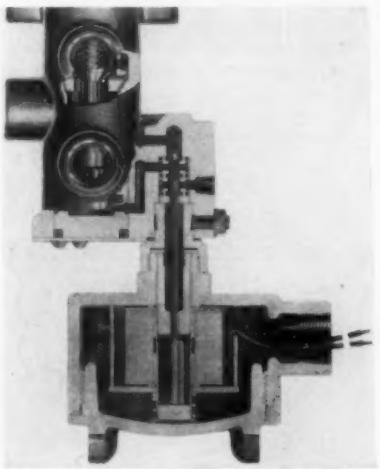
Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage is required.



Direct-reading Spectrometer Has Double Optical System

. . . and focal deck so it may be used photographically for qualitative or semi-quantitative analysis, simultaneously with or alternatively to the direct-reading measurements. Complete analyses normally require less than one minute, it is stated. Results show standard deviations of 1-2%. For simplified servicing and repair, the new "Atomcounter" is built on the unitized construction principle, using components. The complete unit, consisting of a spectrometer, a dual source and the detection, integration, and data presentation circuits, is housed in a metal cabinet 81¼ x 43¾ in. The spectrometer unit consists of a Wadsworth 1.5 meter stigmatic concave grating mount, with a 30,000 line/inch ruling, giving 5.3 ang./mm. and good intensity over a range of 2300 to 4300 ang. Two collimating mirrors produce two identical spectra, one above the other, each at full intensity. This makes it possible to measure two lines very close together, provides double the normal space for mounting photomultipliers, and makes it possible to employ photomultipliers directly behind almost all lines without the need for more mirrors for each channel to deflect the light onto the appropriate photomultiplier. Jarrel-Ash Co., 25 Farwell St., Newtonville, Mass.

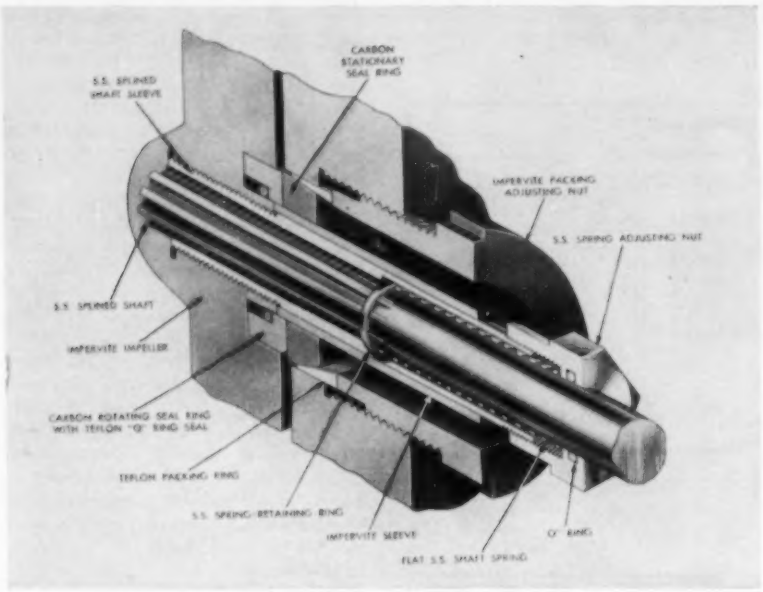
Circle No. **3** *on Reply Card*



Explosion-Proof Solenoid Air Valves are Self-scavenging

. . . when used on dusty installations. Short solenoid strokes mitigate the problem of coil burn-out. The explosion housing cover is removable for access to the solenoid. Interchangeable coils allow conversion to any standard voltage supply. Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif.

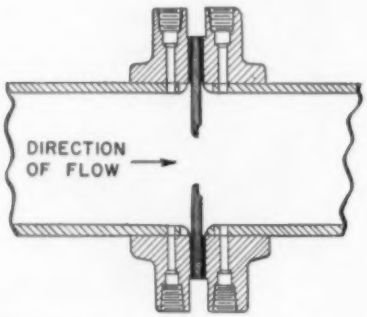
Circle No. **4** *on Reply Card*



Leak-Proof Graphite Centrifugal Pump

Claimed to be immune to thermal shock effects, it will resist the action of a wide range of acids, alkalies, salts, solvents and organics at temperatures to 340° F. Designed for ease and economy in maintenance, the pump can be completely stripped down on the job in as little time as 90 minutes. The "Impervite" centrifugal pump is made of resin-impregnated graphite having a very low temperature coefficient of expansion. Six models are currently available with capacities from 25 to 200 gpm at heads of 20 to 100 ft. Motors are furnished at 1150 or 1750 rpm, depending upon requirements. Falls Industries, Inc., 31837 Aurora Road, Solon, Ohio.

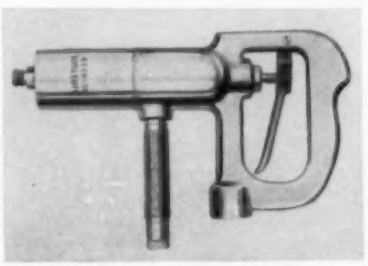
Circle No. **5** *on Reply Card*



New Orifice Design Measures Flows at Varying Viscosity

. . . changes over the Reynolds Number range of 500 to 250,000. The result of European research for the measurement of flow rates of liquids with varying viscosities, the quadrant plate has a rounded upstream face approach. The usual sharp edged orifice plate has predictable performance only for Reynolds Numbers of 15,000 to 50,000. The quadrant orifice plate also can measure small liquid flow rates. Taylor Instrument Companies, 95 Ames St., Rochester 1, N.Y.

Circle No. **6** *on Reply Card*



Lightweight Tool Cleans Small Condenser Tubes

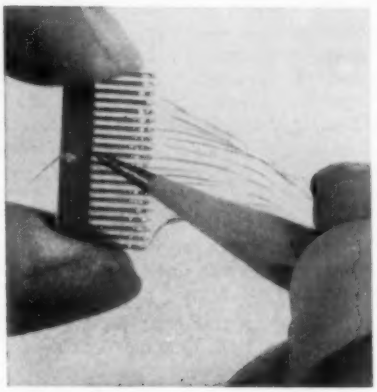
. . . up to 1 in. I.D. and weighs only 11 lb. Air powered, the cleaner operates at high speed and is equipped with an exhaust muffler. It is equipped with either a regular handle or a sleeve valve handle for controlling the water flushing agent which also cools the drill. It can be supplied with a carbide tip drill for cleaning hard deposits. Airetool Mfg. Co., 304 S. Center St., Springfield, Ohio.

Circle No. **7** *on Reply Card*

Reodorants Designed to Mask Odors from Petroleum Refining

. . . in many different phases of operation. The new "Alamask" reodorants are said to have proved successful in such processes as atmospheric distillation, light gasoline rundown, jet ejector and barometric condenser water on vacuum stills, processing low flash stock from sour crudes, flue gas from hydrogen sulfide burners, flares from catalytic cracking, and discharges from vacuum pumps. The materials must be tailored to the individual odor-masking problem, according to the manufacturer. Rhodia, Inc., Industrial Reodorants Div., 230 Park Ave., New York 17, N. Y.

Circle No. **8** *on Reply Card*



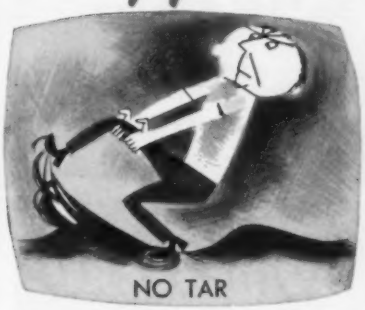
Infrared Heat-Sensing Cell Has 10,000-Time Sensitivity Boost

. . . to allow detection of warm objects over long distances without physical contact. Made of pinpoint specks of lead sulfide on glass, "Ektron" is highly sensitive to ultraviolet and visible light, reaching its peak of sensitivity in the near-infrared. The detector can automatically monitor the exact composition of fluid mixtures flowing through pipes and process vessels by the characteristic infrared "color" of the various components, such as water and gasoline. "Ektron" can also be applied as a replacement of "electric eyes" in switching arrangements. Eastman Kodak Co., Rochester 4, N. Y.

Circle No. **9** *on Reply Card*

Only the Wiggins Gasholder*

NO WATER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A positive mechanical means for (1) relieving seating pressure to permit easy operation, and (2) for pressing the tapered plug firmly into its seat to give drop-tight service, is built into every Homestead Lever-Seald Valve. All operating parts and seating surfaces are fully protected from the corrosive or erosive effect of line fluids.

That is why Lever-Seald Homestead Valves are noted for their extremely long continuous service, with a minimum of maintenance. They are available in semi-steel, steel, stainless, bronze, and other alloys suitable for the service conditions.

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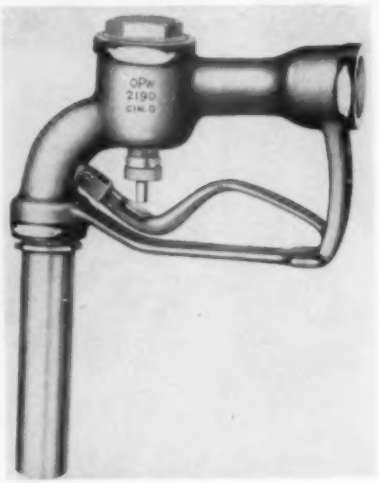
CITY _____ STATE _____

HOMESTEAD VALVE MANUFACTURING COMPANY
"Serving Since 1892"

P.O. Box 43 Coraopolis, Pa.

What's New!



New Nozzle Will Dispense Corrosive Chemicals Safely

. . . because of alloy construction. Especially designed and recommended for aqua ammonia, liquid nitrogen and acetic acid, the Model 2190 nozzle may also be used to dispense petroleum and other chemicals that do not effect and are unaffected by aluminum or stainless steel. Full or controlled flow with shockless closure is claimed. The nozzle is made in 1½ in. size. OPW Corp., 2735 Colerain Ave., Cincinnati, Ohio.

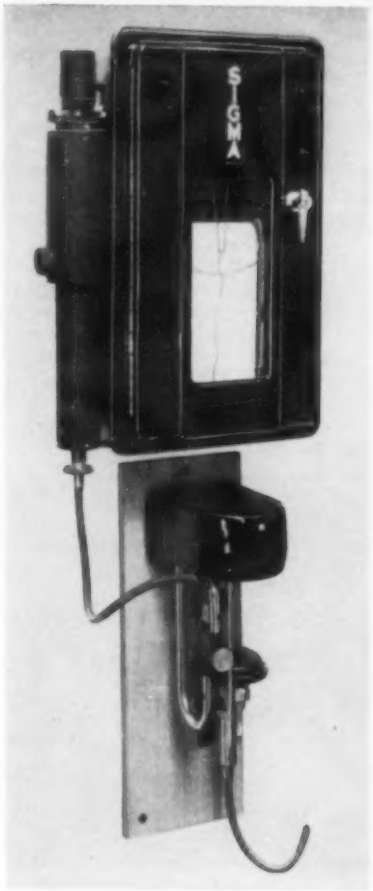
Circle No. **10** *on Reply Card*

New Pressure Strain Gage Has High Frequency Response

. . . for transmitting pressure information from remote or hazardous locations to a central control room several thousand feet distant. It can be used with suitable self-balancing recording potentiometers or cathode-ray oscillographs to measure and control the pressure of chemical and similar processes. The "Teledyne" has a mechanical natural frequency exceeding 2000 cps, and due to its bonded construction is relatively insensitive to vibration. The pressure chamber is corrosion-proof stainless steel. Pressures are exerted on a stainless steel diaphragm which actuates a piston contacting the electrical sensing element—an "elastic member" metal ring onto which are bonded four electrical resistance strain gages arranged in a bridged circuit. Two of the strain gages are bonded onto the internal surface, and two onto the external surface of the ring, thereby being in compression and tension respectively. Increasing pressure produces a proportional electrical unbalance in the electrical bridged circuit, which is

fully temperature compensated. Taber Instrument Corp., Section 38, 111 N. Goudry St., N. Tonawanda, N. Y.

Circle No. **11** *on Reply Card*



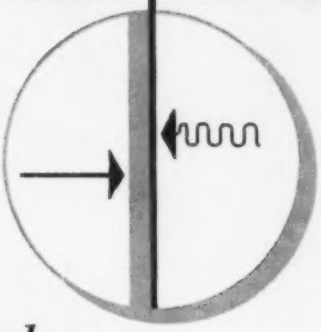
Calorimeter Controls Heat Flow Factor for Fuel Gas Mixtures

. . . having changing densities. It is claimed that the newly modified "Sigma" calorimeter, connected to a pneumatic control, can adjust the mixing of two fuel gases to keep the "heat flow factor" constant (defined as fuel calorific value divided by the square root of the gas specific gravity). The gas flow rate control is inversely proportional to the square root of the gas specific gravity so that heat available at the burner is proportional to the heat flow factor. Fitted with electric alarm contacts, it can give visible or audible warning when the heat flow factor exceeds pre-set limits. Available with recording chart powered either by spring-wound or electrical mechanism. Cosa Corp., 405 Lexington Ave., New York 17, N.Y.

Circle No. **12** *on Reply Card*

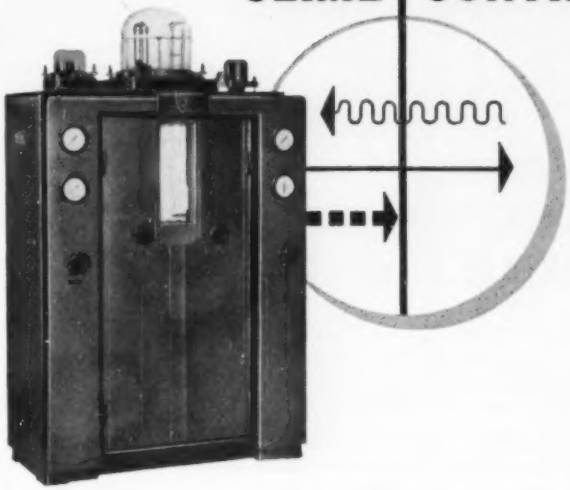
Where you need

HEAT | EXCHANGE



Be sure you have

SLIME | CONTROL



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

WALLACE & TIERNAN

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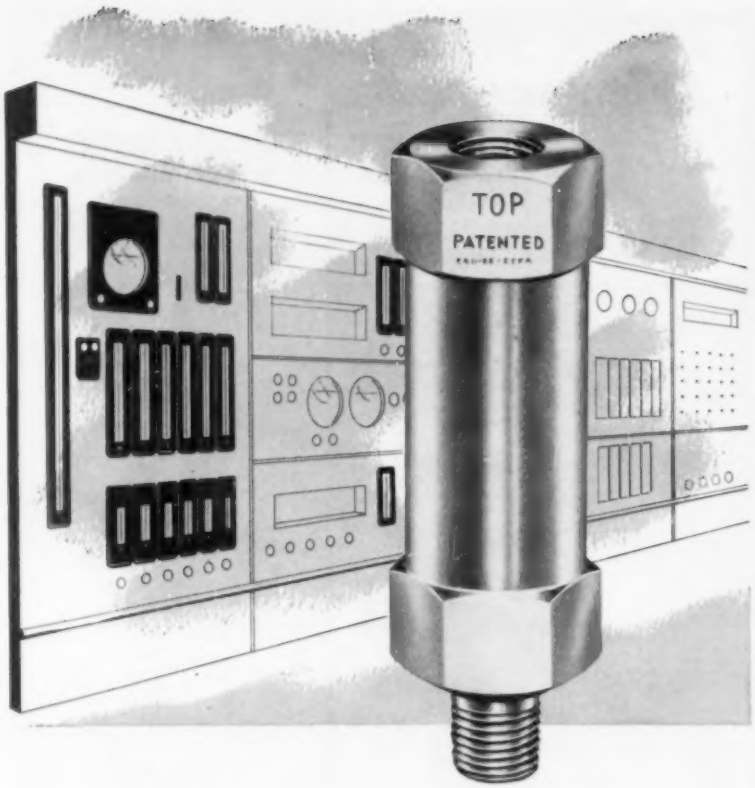
CHLORINATORS • CHEMICAL FEEDERS • SCREENING EQUIPMENT • MAGNETIC SEPARATORS • PRECISION PRESSURE INSTRUMENTS • CATHODIC PROTECTION • FINE CHEMICALS

CD-39

(To obtain more data on advertised products see page 1620)



Positive Protection Against Fluid Blow-out...
MERIAM Float Check Valves

Meriam Float Check Valves offer complete assurance that indicating fluid is safely contained in liquid column gauges even though subjected to surges or momentary over-pressuring. These stainless steel units positively prevent fluid blow-out.

Performing equally well with mercury or light indicating fluids, Meriam Float Check Valves close instantaneously when fluid reaches them. They stay closed until the condition is corrected. All the indicating fluid returns to the manometer after pressure is reduced.

Ask your Meriam Instrument Technical Man about Meriam Accessories or write us.

THE MERIAM INSTRUMENT CO.
10989 Madison Avenue • Cleveland 2, Ohio
WESTERN DIVISION:
4760 E. OLYMPIC BLVD., LOS ANGELES 22, CALIF.
IN CANADA:
PEACOCK BROS., LTD., MONTREAL

MERIAM Instruments
ESTABLISHED 1911
MANOMETERS, METERS AND GAUGES FOR THE ACCURATE MEASUREMENT OF PRESSURES, VACUUMS AND FLOWS OF LIQUIDS AND GASES

Computing Relay Transmitter Controls Process Variables

. . . in constant relationship to each other. Called the "Transet Computing Relay," it is capable of adding, subtracting, averaging and ratioing. Operation is on the pneumatic force-balance principle, handling up to three separate pneumatic input pressures simultaneously with a claimed accuracy of one-half of one percent. Output is linear to any input pressure change. Suggested uses are for process operations where two or three different signals must be compared or where process variables must maintain a constant relationship to each other. A single setting can change the ratioing range from 7 to 1 down to 0.33 to 1. Taylor Instrument Companies, 95 Ames Street, Rochester 1, New York.

Circle No. **13** *on Reply Card*

Electrical Cable Inspector Uses Continuous Scanning Circuitry

. . . to locate direct shorts and identify individual circuits in multi-conductor cables. The "Cable Inspector" is designed for original test and maintenance of control cables, transmission lines, instrument and control panels, feeder and branch circuits, thermocouple leads and communication lines. The inspector consists of two portable units, the "master" which inspects and the "slave" which is used with the master for identification of individual cable circuits. The master and slave may be located as much as 5 miles apart when identifying circuits. In a multiconductor cable (100 circuit maximum) the inspector automatically checks insulation resistance of each conductor to every other conductor and of each conductor to ground. Panascan, 7431 N. Hamlin Ave., Skokie, Ill.

Circle No. **14** *on Reply Card*

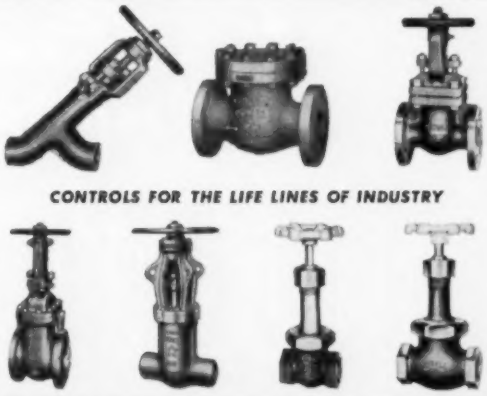
"You see Powell Valves everywhere! And with . . .

. . . good reason! They're famous for dependability. Economical, too.
What's more, Powell has a complete line."

Just name the valve needed...

. . . POWELL CAN SUPPLY IT! Small wonder—since Powell probably makes more kinds of valves and has solved more valve problems than any other organization in the world.

Available through distributors in principal cities. In bronze, iron, steel and corrosion resistant alloys. 1/8" to 30" and 125 pounds to 2500 pounds W.S.P. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.



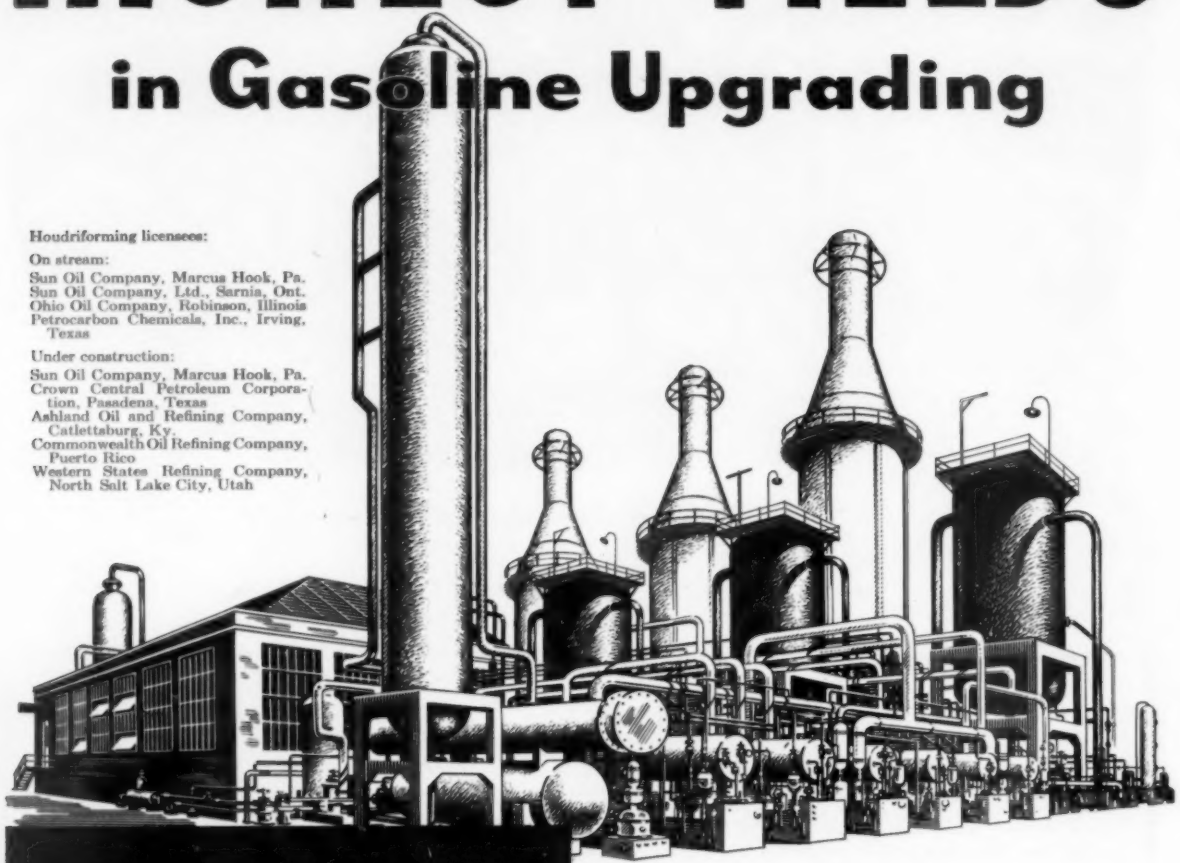
CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves

108th year

 (To obtain more data on advertised products see page 1620)

HOUDRIFORMING
gives
HIGHEST YIELDS
in Gasoline Upgrading



Houdriforming licensees:

On stream:

Sun Oil Company, Marcus Hook, Pa.
Sun Oil Company, Ltd., Sarnia, Ont.
Ohio Oil Company, Robinson, Illinois
Petrocarbon Chemicals, Inc., Irving, Texas

Under construction:

Sun Oil Company, Marcus Hook, Pa.
Crown Central Petroleum Corporation, Pasadena, Texas
Ashland Oil and Refining Company, Catlettsburg, Ky.
Commonwealth Oil Refining Company, Puerto Rico
Western States Refining Company, North Salt Lake City, Utah

HOUDRY

PROCESS CORPORATION

1528 Walnut Street, Philadelphia 2, Pa.

International Representative: World Commerce Corporation, S.A.

PIONEER IN CATALYTIC PROCESSES

Houdriforming catalytic reforming process answers the increasing demand for higher octane motor fuels. Also, this process gives exceptionally high yields of benzene, toluene, and xylenes as well as high octane gasolines and aviation base stocks. Houdriforming is a continuous process, completely flexible.

There are now four Houdriformers on stream, five more are under construction. Among the many features of Houdriforming are longer catalyst life and the restoration of catalyst activity by regeneration *in place*.

Write on your letterhead for a new brochure describing the Houdriforming process.

(To obtain more data on advertised products see page 1620)

What's New!

Temperature Controllers Have Wide Range Precision

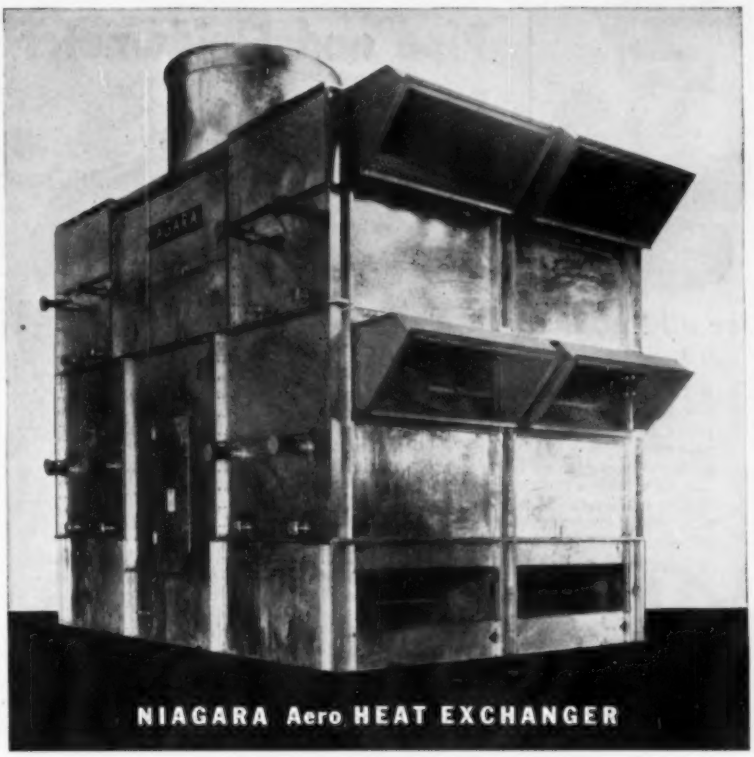
. . . with a claimed 0.001° C. control accuracy from —100° to 500° C. The bridged circuit operates from a stainless steel sheathed, hermetically sealed resistance thermometer. Suggested uses for the "Electron-o-Therm" include control of heaters, pumps, alarms, ovens, furnaces, and for laboratory constant temperature baths and incubators. Technical Equipment Co., 743 Dwight Way, Berkeley 10, Calif.

Circle No. **15** *on Reply Card*

Office Size Ammonia-Dry Reproducer Has High Speed

. . . producing a thousand or more letter or legal size copies per hour. Translucent originals, whether typed, written, drawn, printed, or photographed will give suitable copies. The "Copymaster" produces white-print copies, will take any length of 20-in.-wide sensitized roll stock, and is furnished in office-shade light gray

Thirty Million B. T. U. CAPACITY



Cooling in Chemical Processes with Precise Control of Temperature

The NIAGARA Aero HEAT EXCHANGER cools liquids and gases by evaporative cooling with atmospheric air, removing the heat at the rate of input, controlling temperature precisely. You save 95% of cost of cooling water; you make great savings in pumping, piping, power; quickly recover your installation cost.

You can cool and hold accurately the temperature of all fluids, air and gases, water, oils, solutions, chemical intermediates, coolants for mechanical, electrical and thermal processes. You obtain closed system cooling free from dirt. You solve all the problems of water availability, quality or temperature.

In CHEMICAL PROCESSES this is successfully used in cooling liquids and gases, chemical reactions, condensing distillations and reflux cooling.

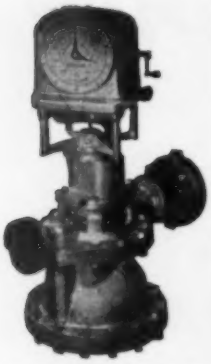
Write for complete information; ask for Bulletins 120 and 124. Address Dept. PP.

NIAGARA BLOWER COMPANY

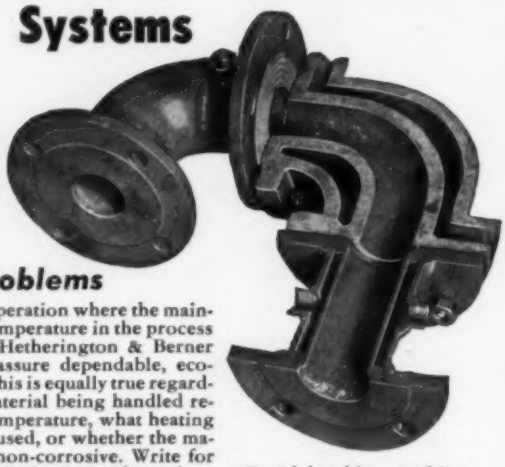
405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Cities of United States and Canada

(To obtain more data on advertised products see page 1620)



COMPLETE Jacketed Pipe and Fluidometer Systems



for all liquid-handling problems

● In any processing operation where the maintenance of a uniform temperature in the process pipes is necessary, a Hetherington & Berner jacketed system will assure dependable, economical production. This is equally true regardless of whether the material being handled requires a hot or cold temperature, what heating or cooling medium is used, or whether the material is corrosive or non-corrosive. Write for Bulletin J-50. If you have a liquid batching problem, involving either light or heavy liquids, jacketed or unjacketed construction, investigate the *Fluidometer System.* This system gives accurate, dependable and *completely automatic* batching and is adaptable to practically any liquid measuring problem, whether it involves gallons, barrels or tank cars. Write for Bulletin Fl-49.

H&B ESTABLISHED 1887

HETHERINGTON & BERNER INC.

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"REFINERY INSTRUMENTS—WHAT MAKES THEM TICK?"

A series of 8 articles by Cornelius E. Shannahan, instrument engineer with M. W. Kellogg Co., dealing with the four basic refinery instruments (pressure, temperature, flow, level), plus sections on controllers, control valves and pneumatic transmission—40 pages, 8¼ x 11¼, paper bound (1951-2) **$1.00**

"VAPORIZATION EQUILIBRIUM CONSTANTS AND ACTIVITY COEFFICIENT CHARTS"

41 working-scale charts (21 equilibrium constant charts for the hydrocarbons from methane to 700°F. boiling point, and 20 activity coefficient charts), plus a description of how to use them—48 pages, 8½ x 11, paper bound (1949) **$1.50**

"SHORT-CUT PROCESS DESIGN METHODS FOR HIGHER PROPANE RECOVERY"

A series of 8 articles by Alan S. Glendening and Charles F. Sanderson, covering rich oil de-ethanizers, absorber refrigeration, multi-stage distillation and gas fractionation—40 pages, 8¼ x 11¼, paper bound (1949) **$1.00**

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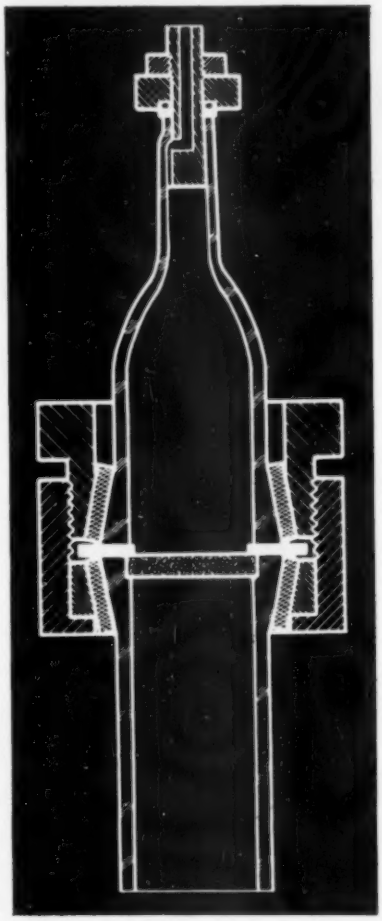
PETROLEUM PROCESSING

330 West 42nd Street, New York 36, N. Y.

What's New!

Hammertone finish. Five models are available, from floor models to portable field models. Peck & Harvey Sales Corp., Chicago 45, Ill.

Circle No. **16** *on Reply Card*



Chromatographic, Ion Exchange Columns Have Variable Lengths

. . . in single units. In addition, removable filter discs permit selection of various filter porosities. The "Ultramax" valve requires no lubricant, permitting close effluent control. Coupling and removable disc assemblies allow extension of the adsorbent bed. The column may be run in continuous back-flow operation by using a second coupling and filter disc at the top. Stock sizes are ¼, ⅜, ½, ¾, and 1 in. heavy-walled tubing with porcelain filter discs. Special columns are manufactured to individual specifications. Fischer & Porter Co., 194 Jacksonville Road, Hatboro, Pa.

Circle No. **17** *on Reply Card*

The Reader AUDITED PAID ABC CIRCULATION *His Mark*

THE ABC SYMBOL, which appears at the head of this page, is your brand—the reader's brand—on this magazine. It stands for Audit Bureau of Circulations. It means that this magazine will stay in business only so long as it continues to serve its readers to their satisfaction.

That Bureau—known for short as ABC—is a voluntary, nonprofit, cooperative association founded in 1914 by a group of publishers, advertisers and advertising agencies who wanted to establish and maintain higher standards of publishing practices than then prevailed. Its primary and specific purpose was to set up yardsticks to appraise circulation values and to verify the claims of publishers as to their circulations. For the buyer of advertising space this provides an effective means to take some of the guesswork out of buying and to reconcile the conflicting claims of competing publishers. BUSINESS WEEK magazine has aptly described ABC as "the publisher's conscience—and cop."

BUT IN DOING that job, ABC performs another function of high importance to the readers of ABC member publications. It provides a constant pressure on the publishers to keep alive in their staffs a sense of primary responsibility to their readers. That is because the most simple and direct method of making a publication responsible to its readers is to place upon it a purchase price, whether by subscription or newsstand purchase. The right to purchase or to refrain from purchasing a publication gives to the reader and to no one else the power to pass effective judgment on the publisher's success in serving the reading public. Each paid publication will grow or languish, will prosper or fail, in proportion as it wins or loses the following of thousands or millions of readers. The readers, by their patronage, record their judgments as to whether the publisher and his publication are measuring up to their responsibility to them.

And that is where the ABC comes into the reader's picture. The newspaper or magazine that carries the ABC symbol on its masthead must in the first place be a paid circulation publication. Moreover, it must conform to the high standards set up by the Bureau as to terms of payment and accounting methods. And again it must open all of its books to the auditors of the Bureau on demand.

SINCE THE INFORMATION thus determined by thorough and impartial audit is periodically made public through the ABC statements and audit reports, it is constantly available to and universally used by advertisers who are considering the purchase of space in an ABC publication. These reports show the circulation trend, as verified and certified by ABC, and thus put the advertisers in a position to know whether or not the publisher is rendering satisfactory service to his readers.

Thus the publisher who submits his publication to the supervision and discipline of ABC affirms in the strongest possible manner that he recognizes his primary obligation is to his readers and that he owes his standing to a voluntary demand by those readers. It follows that the editors of ABC publications must be exceptionally alert to the desires of their readers and responsive to their needs, since any decline in circulation will soon show up in the ABC statements and audit reports.

THAT IS WHY we describe the ABC symbol as the reader's brand. It shows that a publication must be primarily responsive to him and that he holds in his own hands its success or failure. And that ABC symbol is not only a constant reminder to him of that fact, but also an equally constant reminder to all concerned that the reader's willingness to pay for the ABC publication is the acid test of its value to him and to the advertiser.

McGraw-Hill Publishing Company, Inc.

TO POSITION DAMPERS, SLIDE VALVES and other control means →

ASKANIA
PNEU-DRAULIC VALVE POSITIONER

The Askania Pneu-Draulic Valve Positioner combines the advantages of both pneumatic and hydraulic control systems. It provides an air signal proportional to valve position, yet has incompressible fluid working at the heart of the unit.

Almost unlimited power can be smoothly and instantly applied with these positioners. For every increment of input signal between 3 and 15 p.s.i., the cylinder position finds a specific position within 1% of full cylinder stroke.

These positioners are rugged enough to withstand almost any abuse, because the signal amplifier has only one moving part—the well protected jet pipe.

Write for bulletin No. 1—86

ASKANIA REGULATOR COMPANY
244 E. Ontario Street, Chicago 11, Illinois
Subsidiary of General Precision Equipment Corp.

L-P GAS TESTING EQUIPMENT

Tests . . .

• PROPANE • BUTANE • OTHER LIQUIFIED PETROLEUM GASES

VAPOR PRESSURE BOMB

Designed for NGAA Standard No. 2140 requirements. Used for the determination of the gauge vapor pressure of liquified pet oleum gas products. This apparatus consists of a bomb having two sections, or chambers. An upper 80% capacity chamber and a lower 20% capacity chamber. A bleeder valve, inlet valve, and chamber separating valve are included. Bomb and gauge connections use soft rubber gaskets permitting hand tight seals. Each bomb tested to 500 psi. Range 0-300 lbs.

CORROSION TEST BOMB

Tests the corrosiveness of LP gases. An all stainless steel bomb fo· corrosion tests by the copper strip method. Sealed by a neoprene "O" ring w.ich makes it possible to make the bomb pressure tight with the hands and without wrenches. Complete with two nickel plated valves, connecting hose with swivel connections, adapter to ¼-inch pipe.

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Cost Reduction Offered in Line Of Stainless Steel Plug Valves

. . . of the lubricated type. Recommended for use in plants where product contamination can be a problem, the new valves use chrome-plated plugs and are suitable for most services in which the more expensive stellite-coated valves of the same manufacturer had been previously used. The chrome plating backed by stainless steel offers protection against scoring, galling, and other corrosion effects. The new valves are available in the same sizes and types available in the higher priced line. Meter and Valve Div., Rockwell Mfg. Co., 400 No. Lexington Ave., Pittsburgh 8, Penna.

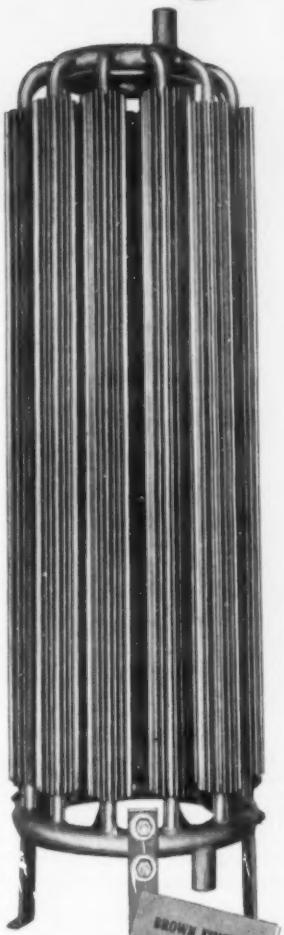
Circle No. **18** *on Reply Card*

Electronic Vacuum Gage Uses A Sealed Radium Source

. . . which emits alpha particles. Ionized gas molecules produced are then collected on a plate to produce a current indicating the measured pressure. The Model 517 "Alpha-

Vertical Mounting of

BROWN FINTUBE TF-18 TANK HEATERS ASSURES MORE EFFICIENT LESS COSTLY OPERATION



● Mounted on legs 10 inches above the tank floor, our TF-18 Heaters are entirely surrounded by the tank liquids. This prevents sediment from settling on the heating surfaces as when an old-fashioned coil in the bottom of the tank is used . . . assures more efficient, less costly heating . . . avoids heating through a layer of sediment . . . and leaves the tank floor uncluttered and easy to clean.

The finned construction provides approximately 7 times more heating surface per foot of tube length than plain bare pipe or tubing. Consequently, TF-18 Heaters transfer **more heat,** faster and at lower temperatures, avoiding coking or damage to heat sensitive materials. Easily installed in existing or new tanks. TF-18 Heaters **do not** require welding inside the tank. Tried, re-ordered and widely used by the country's leading petroleum and chemical concerns.

You can't keep your operations competitive with old fashioned, obsolete methods. Write today. Get full details about these new, fully proved, less costly, more efficient tank heaters.

New fully descriptive Bulletin No. 541 gives dimensions and full details. Write for your copy today.

BROWN FINTUBE
HEAT TRANSFER PRODUCTS

Brown Fintube Co. *Elyria, Ohio*

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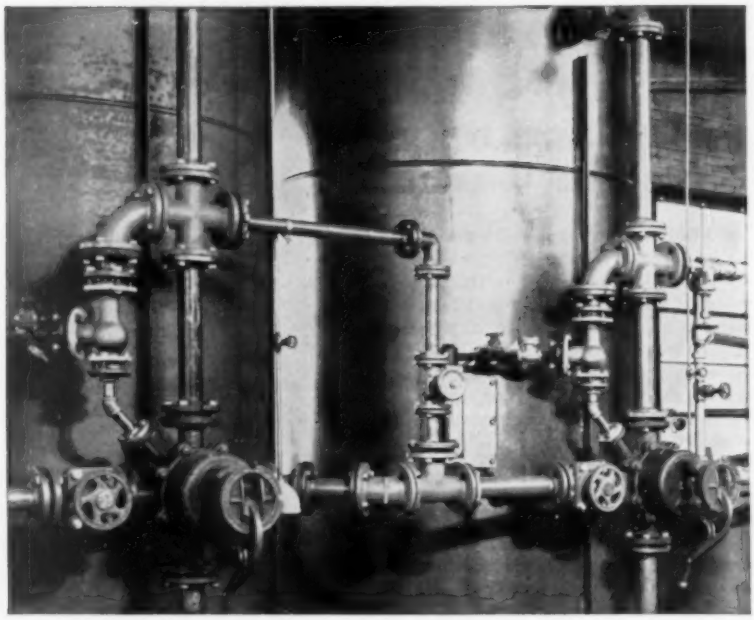
FRIEDRICH UHDE, GMBH, DORTMUND, GERMANY

(To obtain more data on advertised products see page 1620)

DOW

CUT CORROSION COSTS

install corrosion-resistant SARAN LINED STEEL PIPE for long, trouble-free service



Saran lined pipe, fittings and valves are used in this automatic water deionizer in a large water purification system. Installations such as this give trouble-free service for many years.

Corrosion-resistant saran lined steel pipe sharply reduces repair and maintenance costs in corrosive piping installations. Downtime is cut to a minimum because this rigid pipe has high-pressure strength and durability—which mean dependable, long-term service. Easily installed saran lined steel pipe can be cut and threaded in the field—no need for special tools or handling. Wherever superior resistance to most chemicals and solvents is demanded, be sure to consider saran lined pipe, fittings and valves. THE DOW CHEMICAL COMPANY, Midland, Michigan.

RELATED SARAN PRODUCTS

Saran rubber tank lining • Saran rubber molding stock • Saran pipe and fittings • Saran tubing and fittings

Saran Lined Pipe Company
2415 Burdette Ave., Ferndale, Mich.

Please send me a copy of your catalog on saran lined pipe, valves and fittings.

Name_____

Title_____

Company_____

Address_____

City_____ State_____

SP 1171G

you can depend on DOW PLASTICS DOW

tron" can be connected to a recorder and has a six-range coverage of pressures from 1000 to 0.0001 mm. Hg. on a linear scale. It cannot be damaged by exposure to atmospheric pressure and is less susceptible to contamination than hot element vacuum gages. Naresco Equipment Corp., 160 Charlemont St., Newton Highlands 61, Mass.

Circle No. **19** *on Reply Card*

Temperature-Indicating Control Uses Thermistor Element

. . . in what is believed to be the first commercially-available unit of its type. The new Series 560 is designed to operate in the range of 0 to 600° F., and is to be manufactured both as an industrial and as a portable laboratory model (the latter is shown in the photograph). Instrument response accuracy is within 0.25% of full scale. Control accuracy is maintained even if the indicating circuit should become inoperative. The thermistor permits use of a standard meter of rugged construction for temperature indication rather than an easily damaged sensitive pyrometer. Two calibrating adjustment knobs permit control of bandwidth to be changed to almost any desired range. A selector switch permits the unit to be used either as a straight on-off controller or as a time-proportioning controller. The instrument operates on 115 volts, 60 cycle A.C., but control accuracy is unaffected between line voltages of 95 and 130. Also, it is immune to ambient temperature change between 0 and 150° F. Probe leads to the controller can be up to 200 ft. long without affecting either signal strength or accuracy of measurement at the indicating-controller. Fenwal, Inc., Ashland, Mass.

Circle No. **20** *on Reply Card*

New Larger Size Magnetic Mixing Unit Has Wide Uses

. . . for stirring fluid materials in open or closed vessels. The "King-Size Magne-Stir" has a built-in hot plate for heating and mixing simultaneously, as well as so-called "Egg-Bars" for use in round bottom vessels. Housing is made of cast aluminum. Speed control is by means of an Ohmite rheostat. Egg-bars can be supplied with Teflon or glass coverings. Six different shapes are available. Housing has two support rods to fasten the stirrer to a setup frame or to support the glassware. Labline, Inc., 217-221 Desplaines St., Chicago 6, Ill.

Circle No. **21** *on Reply Card*

Trade Literature

Industrial Scale Models

. . . and their uses as engineering tools to simplify plant construction and lower capital expenditures described in new bulletin. Project Models, Inc., 53 Rose St., New York 38, N. Y.

Circle No. **22** *on Reply Card*

Tube Stress Rupture Data

. . . for materials in high-temperature service; *TDC 153-A* includes eleven tubing materials from carbon steel to stainless steel. The Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.

Circle No. **23** *on Reply Card*

Save time!...
Save money!...
Do a better job!.....

WITH COMPACT
EASY TO OPERATE
MANIFOLDS

HAMER *Visible Shut-off*
LINE BLIND VALVES

Compact HAMER "Tee" and "Ell" Line Blind Valves are fast, simple to operate, provide **positive and permanent shut-off** and free from fire hazards. One man opens or blinds valves in *one minute*. They can be readily substituted in existing installations with a minimum of down. Often in a modernization program the salvage value of other valves and pipe fittings will nearly pay for the change-over to Hamer Line Blinds.

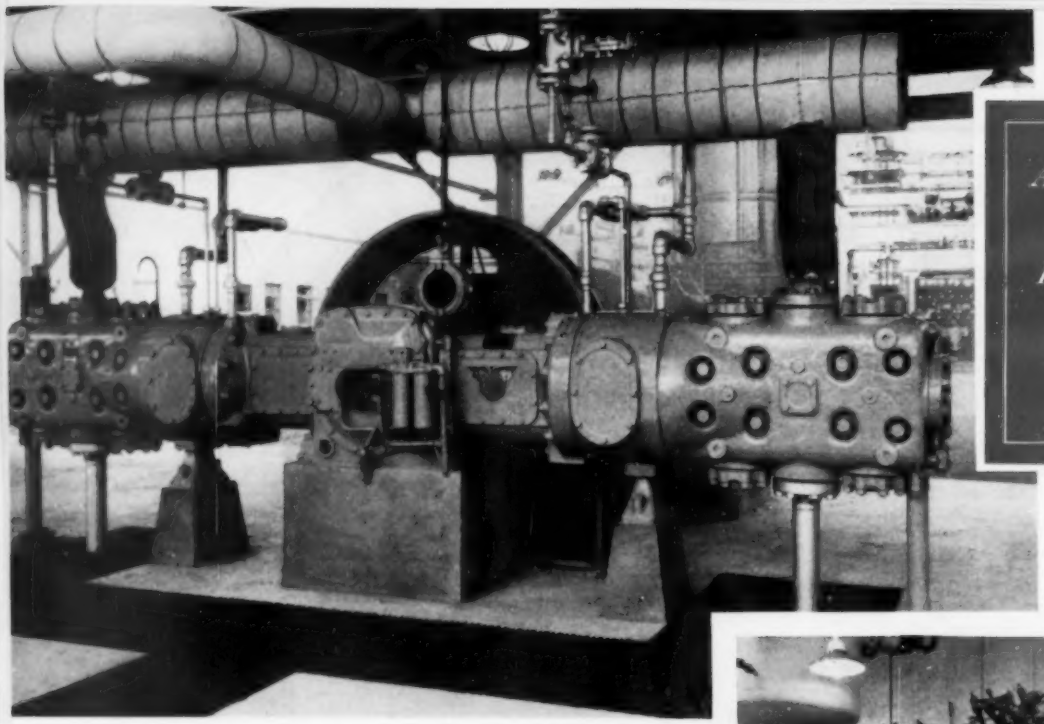
HAMER *Plug Valves*
Will not stick. Plug adjustment nut makes it easy to open or close valve yet assures positive control of the plug.

HAMER

Send for free catalog.

VALVES, INC.
2919 Gardenia Avenue
Long Beach 6, California
Representatives throughout to United States

(To obtain more data on advertised products see page 1620)

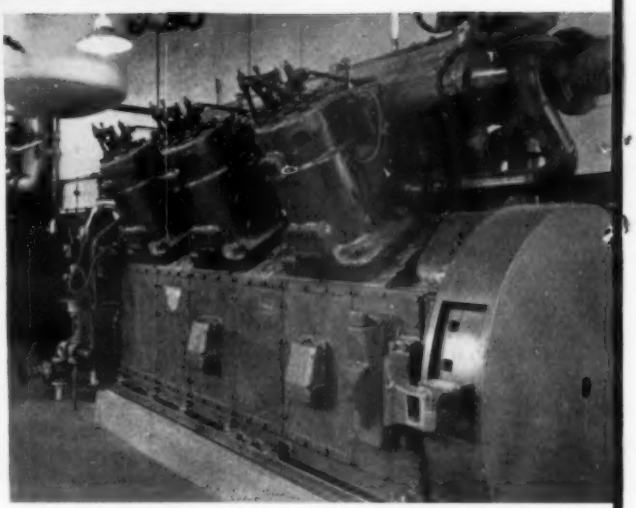


Another Example of Efficient Power at Lower Cost

One of the two Cooper-Bessemer EM compressors, rated at 300 hp, serving in Canadian Oil's UOP Platforming operation. Note the simple, neat and compact arrangement of this "open air" unit.

EM's and GMX's at Sarnia...

NEW HIGH'S IN COMPRESSOR EFFICIENCY for higher octane gasoline



Two 6-cylinder Cooper-Bessemer GMX compressors, rated at 330 hp at 400 rpm, being installed to recirculate gas for the Houdriformer process at Sun Oil Company's new Sarnia, Ontario plant.

COOPER-BESSEMER 2-cylinder EM's and 6-cylinder GMX's — offer efficient compressor service for two different oil companies employing different processes at Sarnia, Ontario.

At the Sarnia refinery of Canadian Oil Refineries, Ltd., two motor-driven EM compressors recycle hydrogen for their new UOP Platforming unit. This unit, charging nearly 3800 barrels per stream day, produces high yields of gasoline with an octane number reaching well into the 90's. Equipped with non-lubricated cylinders, EM's play a vital and dependable role in this production of high octane gasoline.

And, for the new Houdriformer of a similar capacity at Sun Oil Company's Sarnia plant, two Cooper-Bessemer GMX V-Angles, also with non-lubricated hydrogen cylinders, are used in the recirculation of gases. This catalytic reforming unit likewise upgrades low octane naphthas to high quality motor fuels.

Whether you are considering UOP Platforming, a Houdriformer, or other operations requiring compressors of virtually any type, — Cooper-Bessemer offers more than a century of reliable compressor building experience. Contact your nearest office for detailed information.

MOUNT VERNON, OHIO
COOPER-BESSEMER
GROVE CITY, PENNA.

New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS

What's New!

Infrared Spectrometer

. . . with interchangeable parts, to allow operation in ultraviolet, visible, near infrared, fundamental and far-infrared regions; bulletin describes the "Model 112 Single Beam, Double Pass" recording infrared spectrometer with operating specifications. Perkin-Elmer Corp., Norwalk, Conn.

Circle No. **24** *on Reply Card*

Polypropylene Glycol Data

. . . including physical properties, specifications, shipping and compatabilities with other materials in bulletion *F-7220A;* discusses application as a lubricant, brake fluid, mold lubricant, and other uses. Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.

Circle No. **25** *on Reply Card*

Flange and Coupling Selector

. . . slide rule for series 15 and 30 flanges, and 3000 and 6000 lb. couplings; includes pertinent physical and dimensional data and pipe standard table for schedules 10 to 160. Address request on company letterhead to The Nooter Corp., 1400 S. 2nd St., St. Louis 4, Mo.

Do Not Use Reply Card

Temperature Regulators

. . . thermostatically controlled described in *Bulletin S-6;* gives specifications, where and how to use, installation "musts," overheat protection, and engineering tables. Lawler Automatic Controls, Inc., 453 North MacQuesten Parkway, Mt. Vernon, N. Y.

Circle No. **26** *on Reply Card*

Arc Welding Electrodes

. . . for mild and low alloy steels; 30-page catalog gives applications, weld chemical and physical properties, procedures and engineering data. Metal & Thermit Corp., 100 E. 42nd St., New York 17, N. Y.

Circle No. **27** *on Reply Card*

New Wrought Aluminum Alloy

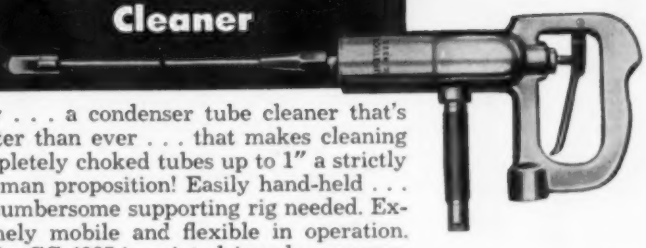
. . . designations becoming effective Oct., 1954, given in *The Aluminum Association Alloy Designation System for Wrought Aluminum;* compares superseded commercial designations with new numbering system. The Aluminum Association, 420 Lexington Ave., New York 17, N. Y.

Circle No. **28** *on Reply Card*

NEW

light weight...
quiet...
high speed...
fast cleaning...

the AIRETOOL CC-4325 Condenser Tube Cleaner



Now . . . a condenser tube cleaner that's lighter than ever . . . that makes cleaning completely choked tubes up to 1" a strictly one-man proposition! Easily hand-held . . . no cumbersome supporting rig needed. Extremely mobile and flexible in operation.

The CC-4325 is quiet; driven by a powerful two-stage, muffled, air motor with a built-in flushing system that insures cooler running of the drill. A quick shut-off sleeve valve controls the flushing agent, and a trigger type valve controls motor speed. When used with a carbide tip drill, the CC-4325 makes short work of cleaning tubes completely choked with hardest deposits.

The New CC-4325 Condenser Tube Cleaner is only one of the new developments of The Airetool Mfg. Co., for many years leaders in the field of tube cleaning and expansion tools. There's an Airetool tube cleaner and expander for every type of tubular construction . . . Write for complete details.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

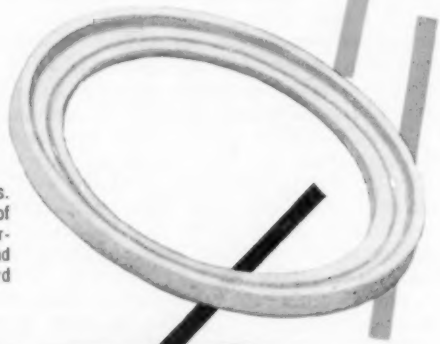
BRANCH OFFICES: New York • Chicago • Philadelphia • Tulsa • Houston • Baton Rouge
Representatives in principal cities in U.S.A., Canada, Mexico, South America, England, Japan

Outlast other gaskets 10 to 1

Chemiseal TEFLON-Jacketed Gaskets, Types 1-339WA and 10-339WA. Compressed asbestos, sandwiched between woven asbestos, enclosed in a TEFLON envelope. Ideal for glass-lined steel connections. Seal at low bolt loads.

CHEMISEAL GASKETS made of Teflon

Chemiseal TEFLON-Jacketed Gaskets, Types T6N or T6-300. Standard for Corning conical flanges. Seal at low bolt loads. Sizes for all conical-flanged glass pipe from 1 in. to 6 in.



Chemiseal Snap-on Type 820 Gaskets. Molded of TEFLON to match contour of conical-end glass pipe, they assure perfect, automatic centering of joints and free flow of materials. For all standard pipe sizes from ¼ in. to 6 in.

Write for Catalog No. TG-953.

UNITED STATES GASKET COMPANY

CAMDEN 1 • NEW JERSEY

FABRICATORS OF duPont TEFLON, Kellogg KEL-F AND OTHER PLASTICS

Representatives in Principal Cities Throughout the World

(To obtain more data on advertised products see page 1620)

What's New!

Acetylene Derivatives

. . . soon to be available from a high-pressure, commercial plant now under construction; *Bulletin M-104R* contains prices, availabilities, physical forms and suggested uses. General Aniline & Film Corp., Commercial Development Dept., 435 Hudson St., New York 14, N. Y.

Circle No. **29** *on Reply Card*

Vibration Meter

. . . provides direct indication of amplitude and velocity of oscillatory motions; *Bulletin CEC-1505C* gives description, prices, and uses for testing engines and pumps, and as a warning device when equipment vibration is critical. Consolidated Engineering Corp., 300 North Sierra Madre Villa, Pasadena 15, Calif.

Circle No. **30** *on Reply Card*

Midget Centrifugal Pumps

. . . for industrial use; *Bulletin 110* gives specifications, performance, and mounting diagrams and dimensions for ⅛ to ¾ H.P. pumps developing 6 to 65 psi and handling up to 70 gpm. Eastern Industries, Inc., 100 Skiff St., Hamden 14, Conn.

Circle No. **31** *on Reply Card*

Steam Coil Tank Heater

. . . for heating liquid contents by forming a thermal siphon circulation; *Bulletin 541* gives specifications, applications and description of "TF-18 Thermo-Flo" tank heaters. Brown Fintube Co., Elyria, Ohio.

Circle No. **32** *on Reply Card*

Steam and Gas Flow Controller

. . . operates to indicate weight flow of steam or gas by upstream pressure only, independent of downsteam pressure fluctuations; *Catalog 5001* gives specifications, process applications and description of the "Critiflo-Meter." King Engineering Corp., Box 610, Ann Arbor, Michigan.

Circle No. **33** *on Reply Card*

Filters, Pumps, Exchangers

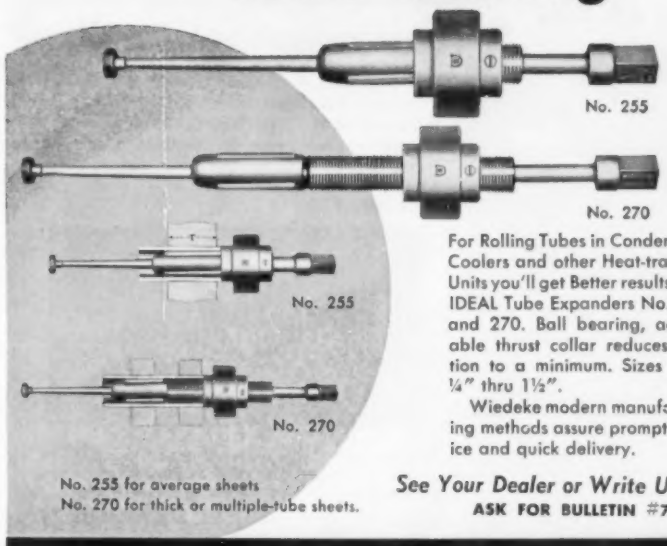
. . . for the chemical process industries described in *Catalog CEC-55*; gives descriptions, use and application data, and specifications for pressure filters, centrifugal pumps, heat exchangers, ion exchangers, and rubber lining services. Industrial Filter and Pump Mfg. Co., 5900 Ogden Ave., Chicago 50, Ill.

Circle No. **34** *on Reply Card*

IDEAL

Precision-Built for faster, smoother

Tube Rolling



No. 255 for average sheets
No. 270 for thick or multiple-tube sheets.

For Rolling Tubes in Condensers, Coolers and other Heat-transfer Units you'll get Better results with IDEAL Tube Expanders No. 255 and 270. Ball bearing, adjustable thrust collar reduces friction to a minimum. Sizes from ¼" thru 1½".

Wiedeke modern manufacturing methods assure prompt service and quick delivery.

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ASK FOR BULLETIN #71

THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

AUTO-LITE

TEMPERATURE RECORDING...

Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from $49.50.

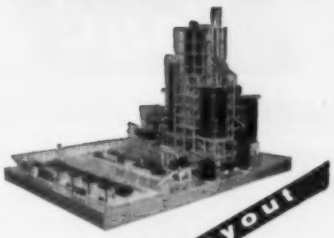
Send for new catalog describing many styles of Auto-Lite temperature Recorders and Indicators.

Model "1000"

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS

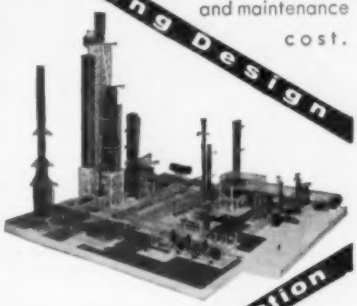
Industrial Models Inc.



Refinery Layout

Scale models help you see through construction and design problems even before the blueprint stage. Piping drawings can be made directly from the model . . . offer great time and cost reduction in design and layout. Personnel are trained before plant begins operation, eliminating costly start-up delays. Save up to 30 times the cost of the model through better, safer design with lower operating and maintenance cost.

Piping Design



Field Construction

Industrial Models, Inc. is an organization of experienced engineers and craftsmen . . . specialists in scale model construction of plants, laboratories and products. Industrial Models' three completely equipped shops and staff of field engineers are at your service. Write for detailed brochure.

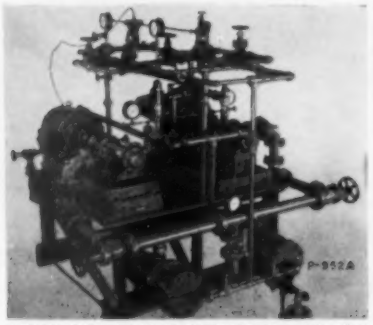
Operator Training

Industrial Models, Inc.

2311 SCONSET RD. WILMINGTON 3, DEL.
CLEVELAND • NEW YORK • THE HAGUE

Now!

MORE COMPACT THAN EVER..



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-E82H size No. 25 unit.

NATIONAL AIROIL

FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped, ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40—very interesting and informative.

- OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
- STEAM ATOMIZING OIL BURNERS
- SLUDGE BURNERS, Steam Atomizing
- MOTOR-DRIVEN ROTARY OIL BURNERS
- MECHANICAL PRESSURE ATOMIZING OIL BURNERS
- DUAL STAGE, Combining Steam and Mechanical Atomization
- LOW AIR PRESSURE OIL BURNERS
- AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
- GAS BURNERS
- COMBINATION GAS & OIL BURNERS
- FUEL OIL PUMPING and HEATING UNITS
- FURNACE RELIEF DOORS
- OBSERVATION PORTS
- SPECIAL REFRACTORY SHAPES

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

1297 East Sedgley Avenue, Philadelphia 34, Pa.
Southwestern Division: 2512 S. Blvd., Houston 6, Texas

HIGHEST QUALITY

SUPERIOR CRAFTSMANSHIP

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FABRICATORS OF
PRESSURE VESSELS
PROCESSING TANKS
STORAGE TANKS
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STAINLESS STEEL • NICKEL
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Flexible facilities accommodate individual designs for pilot plant or production. Equipment built in a variety of sizes and finishes to your exact requirements.

Superior Craftsmanship

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For over half a century Cream City Boiler Company has been a recognized leader in the fabricating field. Today our experienced craftsmen and versatile methods give you more dependable, economical, high quality equipment — as you want it — when you want it.

Our engineers will assist you in the selection of the most economical design for your requirements.

WRITE OR WIRE FOR NAME AND ADDRESS OF NEAREST REPRESENTATIVE.

CREAM CITY BOILER CO.

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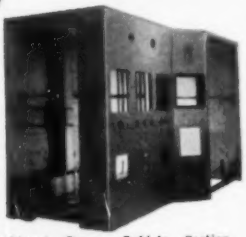
MILWAUKEE 46, WISCONSIN

Figure on FALSTROM for Custom-built Quality in PANELS & CUBICLES



(Above) Corner Cubicle Section.
(Below) Refinery Cubicle with Mimic Flow Diagram in Color.

VISIT BOOTH 711 1st INTL. AUTOMATION EXPOSITION
244th Regiment Armory - N.Y.C.
Nov. 29-Dec. 2

Falstrom Standard Production Methods Can Save You Money On Every Job! Specifying FALSTROM for your panelboard requirements means you obtain quality production with a maximum of economy. FALSTROM production techniques make use of stock tools and dies, standardized formed construction methods and standard paint finishes wherever possible. For complete information on FALSTROM panels, request new Bulletin 143; for a quotation on a specific assembly, send blueprints or sketches. Either way, there is no obligation.

Telephone: PRescott 7-0013

FALSTROM COMPANY

59 FALSTROM COURT
PASSAIC, NEW JERSEY

Multi-Stream Steam Generators

. . . designed to utilize several separate refinery hot oil streams in the same exchanger for the economical production of steam; *Bulletin MSG-1* describes construction of multiple separate tube bundle exchangers for conservation of refinery waste heat. Henry Vogt Machine Co., Louisville 10, Ky.

Circle No. **35** *on Reply Card*

Automatic Valve Controllers

. . . featuring sensitivity and automatic power operation, with valve travel limited by pre-set torque to prevent overload; *Catalog L-54* describes "Limitorque" valve controllers and their applications. Philadelphia Gear Works, Erie Ave. and G St., Philadelphia 34, Pa.

Circle No. **36** *on Reply Card*

Sealed Electric Heater

. . . in copper sheathed, mineral insulated cable for heating metals, pipe lines, and liquids; *Bulletin 1603* gives applications and performance characteristics. Nelson Electric Mfg. Co., 217 No. Detroit, Tulsa, Okla.

Circle No. **37** *on Reply Card*

Generators, Turbines, Motors

. . . and other process industry electric equipment described in bulletin *GED-1966A*; covers power generation, distribution, utilization, instrumentation, and applications to the process industries. General Electric Co., Schenectady 5, N. Y.

Circle No. **38** *on Reply Card*

Atomic Power Plant

. . . reactor systems, the Durban, South Africa, refinery and the world's largest two-stage crude distillation unit at Gulf Oil Corp.'s Philadelphia refinery described in May-June 1954 issue of *Heating Engineering*. Foster Wheeler Corp., 165 Bdwy, New York 6, N. Y.

Circle No. **39** *on Reply Card*

Electric Telemetering

. . . for high speed transmission of system variables to a central location; *I.D.S. 9.1-8a* describes use with direct or microwave connection, and gives transmitter and receiver specifications. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

Circle No. **40** *on Reply Card*

Hand Threading Stainless Pipe

. . . discussed regarding equipment and methods needed; *Data Card TDC 147* is intended to assist pipe fitters using hand tools in the shop or field. Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.

Circle No. **41** *on Reply Card*

Gas-Oil Burner

. . . specifications and dimensions; *Bulletin R-230* gives schematic layouts for gas, oil and gas-oil burner applications. Eclipse Fuel Engineering Co., 1001 Buchanan St., Rockford, Ill.

Circle No. **42** *on Reply Card*

Glossary of Iron Casting Terms

. . . explains over 150 technical terms that are used between suppliers and users of ferrous and non-ferrous castings. International Nickel, New York 5, N. Y.

Circle No. **43** *on Reply Card*

GLITSCH
LARGE...
OR SMALL . . .
TRAYS
Simple and adaptable in design, GLITSCH "Truss-Type" lightweight trays can be designed for any process requirement with respect to tray size, process layout, type of flow, type and shape of downcomer, weirs, wells, and size and shape bubble caps as well as suitable corrosion resistant materials.
GLITSCH BUBBLE CAPS
Dies for 287 different cap and riser assemblies are now available. The cap styles can be varied further by a wide range of slots. Holddown styles simplify clean-outs, reduce "off-stream" time to a minimum.
Glitsch
FRITZ W. GLITSCH & SONS, INC.
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DALLAS 2, TEXAS
Your engineering staff can effect definite savings in initial designing by utilizing GLITSCH world-wide experience in plans, design and fabrication of tower internals. Cost analyses are available promptly.
SALES OFFICES: New York • Chicago • Cleveland • Houston • Tulsa • Los Angeles

(To obtain more data on advertised products see page 1620)

Drafting Room Equipment

. . . including filing units, drafting tables and accessories; 32-page catalog gives illustrations, specifications and prices. Hamilton Manufacturing Co., Two Rivers, Wis.

Circle No. **44** *on Reply Card*

Dew Point Hygrometer

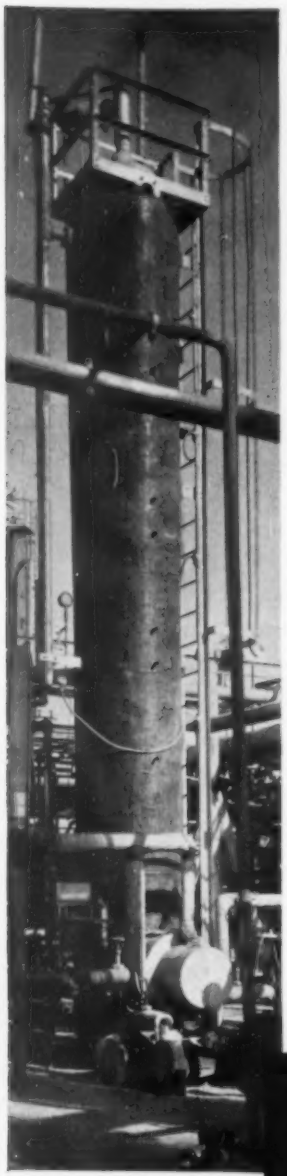
. . . for process gas streams with changing compositions; brochure gives description, applications, and specifications. Burton Manuf. Co., 11201 W. Pico Blvd., Los Angeles 64, Calif.

Circle No. **45** *on Reply Card*

Electric Tube Furnaces

. . . for the laboratory, capable of continuous operation up to 2650° F.; *Bulletin 310* lists types, dimensions and prices. Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Circle No. **46** *on Reply Card*



Texas Refinery Cuts Tower Cleaning Time 79%

¶ REMOVING asphaltic deposits from 45 foot absorber tower previously took 4 days. Estimated production loss due to shut-down: $28,800.
¶ INTRODUCTION of Oakite chemical circulation method of cleaning involving rapid-action Oakite detergents cut time to 20 hours. Brought production loss down to less than one day. Actual cost of cleaning with Oakite method only one third of former manual method. ¶ THIS IS BUT one example of the kind of savings you can realize with tested Oakite methods.
And it's only one of many Petroleum cleaning operations you'll find concisely discussed in the FREE booklet, "What Petroleum Men Should Know To Simplify Cleaning." ¶ ITS 48 PAGES are packed with ideas for saving money, increasing production. Ask your Oakite Representative for a copy.
Or write Oakite Products, Inc., 50D Rector Street, New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. and Canada

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE

Gas Analysers

. . . for thermal conductivity measurements, and useful for such gases as ammonia, carbon dioxide, hydrogen, methanol, propane, and sulfur dioxide, as well as several others: four-page brochure explains principle of operation and gives physical specifications. Charles Engelhard, Inc., 850 Passaic Ave., East Newark, N. J.

Circle No. **47** *on Reply Card*

Multi-V-Belt Selection Guide

. . . assists in design or re-design of standard and high capacity drives; 76-page *Engineering Handbook* covers selection, installation, care, principles and engineering design for all types of V-belt drives. Address request on company letterhead to B. F. Goodrich Co., Industrial Products Div., Akron, Ohio.

Do Not Use Reply Card

Engineering Services

. . . offered by the company; booklet describes activities in research, process development, equipment design (including design and sale of "packaged" plants), plant operation and "trouble shooting" for improved operation, cost analyses for optimum size and design, advisory functions. Foster D. Snell, Inc., Engineering Division, 29 W. 15th St., New York 11.

Circle No. **48** *on Reply Card*

Fatty Chemicals and Oils

. . . derived from vegetable, animal and marine life as process raw materials and intermediates; 40-page catalog lists complete "Hydrofol" line of fatty acids, glycerides, sperm oil products and aldol alcohols; contains compositions, uses, specifications and general information. Archer-Daniels-Midland Co., Chemical Products Div., 2191 W. 110th St., Cleveland 2, Ohio.

Circle No. **49** *on Reply Card*

Exchanger and Condenser Tubes

. . . of copper, copper base alloy, aluminum and welded and brazed steel tube; "An Opportunity to Cut Costs and Increase Capacity with Wolverine Trufin" covers economic factors, case histories, and sample design calculations for heat transfer areas and pressure drops. Wolverine Tube, Division of Calumet & Hecla, Inc., 1852 Guardian Bldg., Detroit 26, Mich.

Circle No. **50** *on Reply Card*

Gulf Oil gives 7 reasons why **ALUMINUM PAINT** is used at its Port Arthur Refinery

Aluminum paint has been in continuous use since 1925 at Gulf Oil Corporation's Port Arthur, Texas, Refinery. A two-year field test at that time, and subsequent tests, prompted Gulf to adopt aluminum paint as a standard finish for many of its tanks, towers, buildings, process units and overhead piping installations. Here's what the tests have shown:

1. Aluminum paint has unusual qualities of *durability.*
2. The "leafing" quality of aluminum paint provides an excellent *moisture seal* against the high humidity and rainfall of the area.
3. Aluminum paint is *economical.* Some applications have had a life as long as 8 years.
4. It provides a good heat reflective surface for tank roofs . . . helps to reduce stock losses caused by evaporation.
5. Its slick, hard surface resists soot and dirt, provides good *long-term appearance.*
6. Aluminum paint is *easy to apply, with high spreading rate.*
7. It has *excellent one-coat hiding power.*

ALCOA does not make paint, but Alcoa Aluminum Pigments are used in more aluminum paints than any other brand. Special formulas have been developed by your paint manufacturer to solve individual problems. Paints made to these formulas actually cost you less, last longer, give utmost protection against heat, cold, sun, rain, smoke and fumes. Write us today for FREE BOOKLET, *Painting With Aluminum.*

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

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Please send me your FREE BOOKLET, *Painting with Aluminum.* I plan to paint_____

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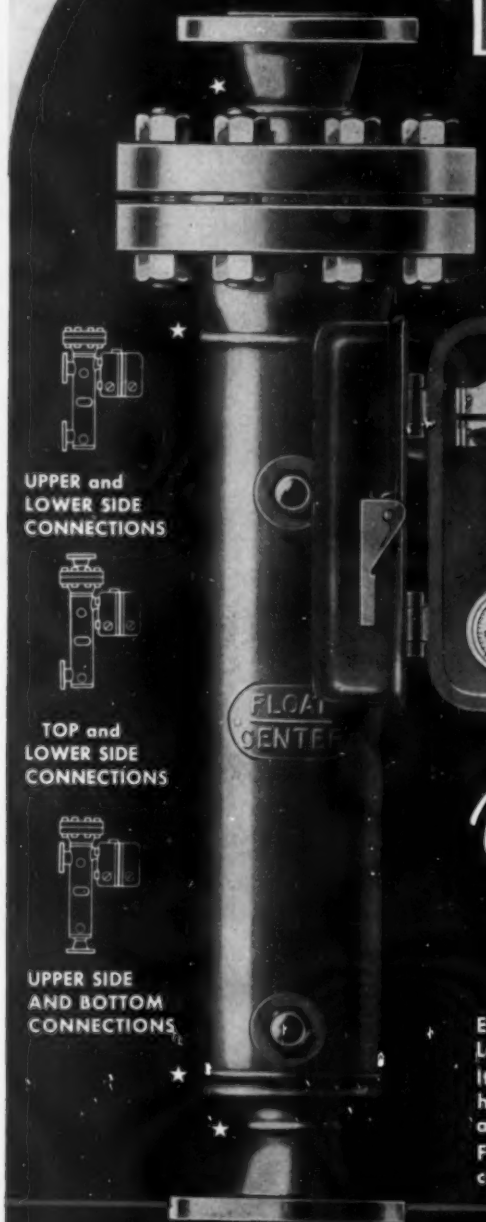

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Factory calibrating or zeroing adjustment produces a correct 3 to 15 pound signal output for full float range operation, as particularly required in liquid level indication. Output signal of controller is linear as related to level height change.

Simple level adjustment indicating dial.

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FISHER Since 1880

Industrial Pumps

. . . of centrifugal and reciprocating types, for petroleum and other applications; 108-page *Industrial Catalog I-54* gives construction information, performance and selection tables, and information concerning liquid materials handling. The Deming Company, Salem, Ohio.

Circle No. **51** *on Reply Card*

Ethylene Glycol Data

. . . on physical properties, specifications, shipping, constant boiling mixtures, physiological properties and uses in bulletin *F-8327*. Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.

Circle No. **52** *on Reply Card*

Molybdenum Chemicals

. . . and their application for catalysts and the process industries; *Bulletin Ch-1* gives uses, properties, and sources for 7 commonly used molybdenum chemical products. Climax Molybdenum Co., 500 Fifth Ave., New York 36, N. Y.

Circle No. **53** *on Reply Card*

Pressure Recorders

. . . and elements for process applications; 24-page *Bulletin 6-10* describes construction principles and lists standard process ranges and special accessories. The Foxboro Co., Foxboro, Mass.

Circle No. **54** *on Reply Card*

Temperature Monitoring System

. . . gives alarm when pre-set temperature limits are exceeded, monitors up to several hundred points from —320° to +3000° F.; *Bulletin 70* gives applications, operation, and specifications. Thermo Electric Co., Inc., Saddle River Township, Rochelle Park Post Office, N. J.

Circle No. **55** *on Reply Card*

Welding and Cutting Equipment

. . . used by job shops and maintenance departments; 52-page *Catalog ADC 662B* describes and illustrates equipment with specifications and explanation of how each item works. Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.

Circle No. **56** *on Reply Card*

Automatic Control

. . . at Sun Oil Co.'s new aromatic plant: how to install thermocouples and differential head type flow meters, and other articles on instrumentation in Vol. 7, No. 4, 1954 of *Instrumentation*. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

Circle No. **57** *on Reply Card*

Chemical Process Pumps

. . . designed especially for pumping acids, alkaline liquors, slurries and other process liquids; *Bulletin 725.4* gives construction details, specifications, performance curves and materials of construction. Goulds Pumps, Inc., Dept. OP, Seneca Falls, N. Y.

Circle No. **58** *on Reply Card*

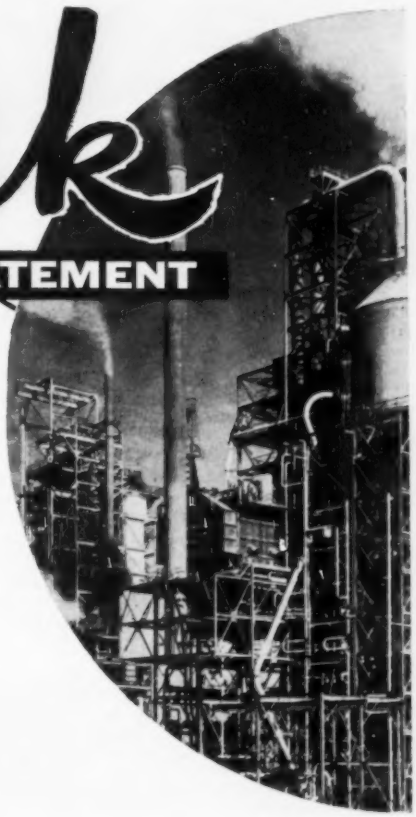
Anhydrous Ammonia Valves

. . . fittings, and control equipment specifically designed for ammonia service; bulletin *A-100* gives specifications and recommended applications. The Bastian-Blessing Co., 4201 W. Peterson Ave., Chicago 30, Ill.

Circle No. **59** *on Reply Card*

Alamask

FOR REFINERY ODOR ABATEMENT



Rhodia offers a complete line of reodorants for use in masking obnoxious odors emanating from petroleum refining operations. These Alamask® products have been plant-tested and proved effective in combating objectionable odors during such phases of refining operations as:

- *Atmospheric distillation units*
- *Light gasoline run down*
- *Processing low flash stock from sour crudes*
- *Flue gases from H_2S burners in boilers*
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- *Topping areas — vacuum pump discharges*
- *Jet ejector and barometric condenser water on vacuum distillation units*

Rhodia's chemists and engineers are experienced in petroleum refinery odor abatement and waste disposal. They are available to you for technical assistance with your malodor problems.

ALAMASK REODORANTS CAN HELP YOU IMPROVE YOUR COMMUNITY, PERSONNEL, AND CUSTOMER RELATIONS.

For complete information and technical aid write to:
Rhodia, Inc., Industrial Reodorants ("Alamask") Division, 230 Park Avenue, New York 17, N. Y.

Rhodia INC.
230 Park Avenue, New York 17, N. Y.

ORONITE
LUBE OIL
ADDITIVES

Photo "A" Shows excessive wear on valve lifter head from the use of oil having inadequate anti-wear properties.

Photo "B" Shows valve lifter head properly lubricated with oil containing Oronite lube oil additives.

(Valve lifters were taken from cars operated in normal passenger service.)

Unique friction measuring machine used to study valve train wear

This specially designed research tool makes it possible to isolate and study the many factors affecting friction and wear. Dust and humidity are controlled in a sealed chamber so that tests can be made in any amount of moisture, nitrogen and carbon dioxide. Studies are made which include the effects of load, speed, types of metal as well as lube oil additives upon friction and surface damage of metals. As a result, Oronite lube oil additives have been developed which minimize valve train wear.

Oronite's research and testing facilities are the most advanced in the nation. With years ahead research it is possible that Oronite additives could provide your finished oil with advantages to win and hold a market.

Oronite will tailor-make additives to your base oils — meeting your price and performance needs. Just contact the Oronite office nearest you for complete information.

With Oronite Additives you can formulate oils to meet the new A.P.I. Service Classifications and can meet specifications for 2-104-B, MIL-0-2104, Supplement I and Series 2 oils.

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Mercantile Securities Building, Dallas 1, Texas

ORONITE CHEMICAL COMPANY

What's New!

Anhydrous and Aqua Ammonia

. . . manufacture, handling, safety and physical properties in 48-page publication *Ammonia*. Spencer Chemical Co., Dwight Bldg., Kansas City, Mo.

Circle No. **60** *on Reply Card*

Did You Miss These?

The following items, reviewed originally in August, have aroused considerable interest among the readers. They are repeated briefly as a service to those who might have missed them the first time they appeared. For details or literature, please use the regular Reply Card in this issue.

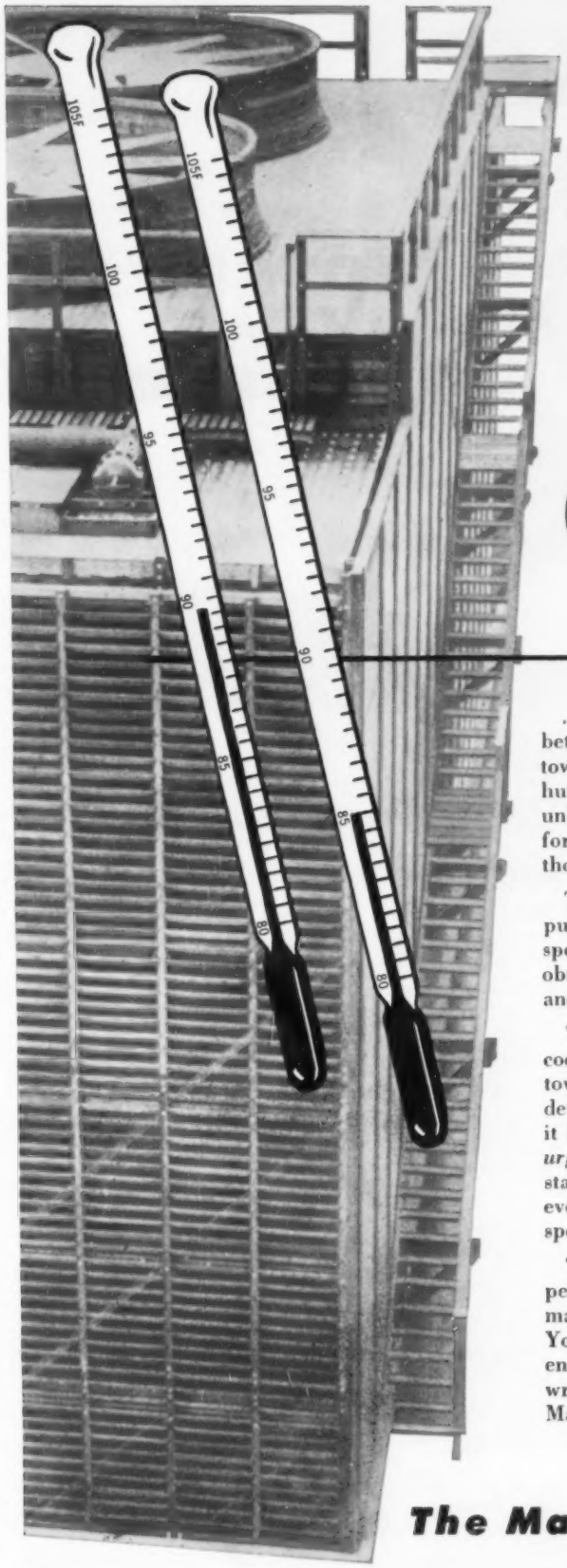
Greater Pressure Produces Tighter Vessel or Pipe Seal

. . . because of its internal design. The new "Flex Ring Closure," for all types of pressure vessels and piping systems, incorporates an internal pressure closing, metal-to-metal seal principle, sealing tighter as the pressure on it increases. Advantages claimed include: less time in opening and closing (only one bolt to operate); less weight; fewer parts; better seal, more safety; space savings, and lower initial cost. The closure comprises four main parts—weld neck, plug, gasket, and a spider. A patented flexible metal gasket is held in compression between the plug and weld neck. This gasket is flexed into an elliptical shape to allow it to pass through the plug opening. Once it is in place, tightening of the spider nut returns the gasket to its round shape for proper seating. Closures are available in the same pressure ratings as ASA flanges and have the same pressure and temperature rating as corresponding ASA raised face flanges. Sillers Engrg. Co., Box 7193, Dallas, Texas.

Circle No. **61** *on Reply Card*

New Multiple Stream Infrared Analyzer Built for Plant Uses

. . . by Phillips Petroleum Co. has already been used successfully in a wide variety of field applications. The analyzer employs an optical system of the double-beam, filter photometer type using non-selective detectors. Completely automatic, it can be used to monitor cyclically as many as five process streams for a single component or a group of components. Alternately, it can utilize continuous single-stream analysis for direct process



What's the difference?

. . . just four or five degrees. But if it is the difference between actual and specified performance of a cooling tower, it is ultra-important. You may spend thousands or hundreds of thousands of dollars for a cooling tower; unless it delivers cold water at the temperature specified for economical operation it will cost more and more thousands in power cost or product recovery.

There is only one sure way to get what you pay for—to purchase a tower that will fulfill your performance specifications under test . . . in your plant. You can only obtain such a tower from a manufacturer whose engineering and research facilities are equal to the task.

Thirty years of research devoted exclusively to water cooling and a complete test plant enable Marley's cooling tower engineering staff (largest in the world) to predetermine tower performance scientifically and to verify it by actual test. That is why Marley not only invites but *urges* every customer to test his tower by any accepted test standard. Marley knows and positively guarantees that every tower it offers today will meet or exceed performance specification.

To help you determine this "difference" in cooling tower performance. Marley publishes helpful technical information to assist in testing all types of cooling towers. You can get this valuable information through Marley engineering representatives in all major cities, or by writing to the Technical Services Department of The Marley Company.

Founder-Member Cooling Tower Institute

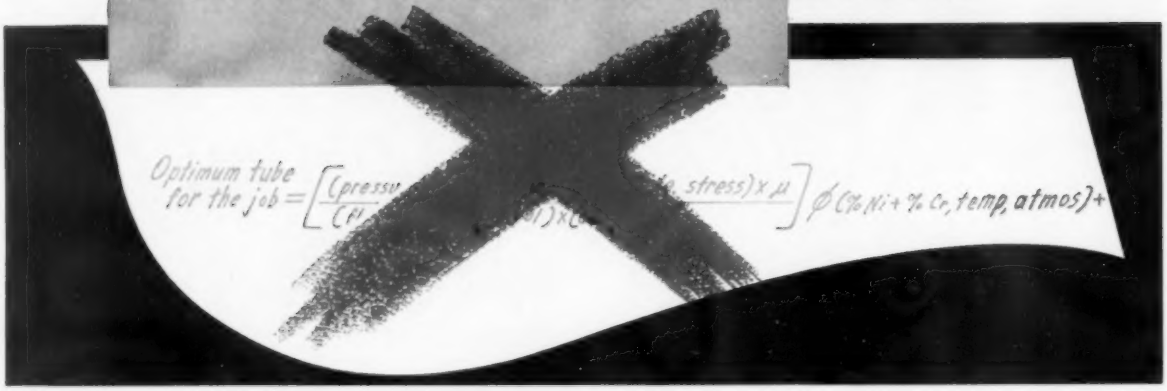
The Marley Company

Kansas City, Mo.

MARLEY

 (To obtain more data on advertised products see page 1620)

WHEN CREEP STRENGTH IS THE FIRST FACTOR



Tube Selection Cannot be Reduced to a Formula — *even a complicated one*

Tubing in service at elevated temperatures will continually deform with time when subjected to stresses considerably below the yield strength of the material. This continued deformation of a material with time due to an applied load, and which eventually leads to fracture, is defined as creep. The ability of tubing to resist creep at elevated temperatures is affected by a variety of factors. Consequently, in the selection of the optimum tubing for a specific application, such variables as composition, melting practice and heat treatment must be considered since these factors in turn influence the creep strength of metals and alloys.

To aid you in the selection of the most suitable tubing, B&W has conducted, and is continuing to conduct creep tests on the numerous B&W Croloys, the results of which can contribute substantially to the proper choice for your particular application. These tests may be considered as actual working tests since commercial materials, in various conditions of heat treatment, are tested at temperatures which may range between 800 and 1800 F. Such creep tests are usually run for a minimum of 10,000 hours in order to obtain accurate creep data.

Other factors which should also be considered in choosing the optimum tubing for a particular application are oxidation and corrosion resistance, environment, tube size, and cost.

In every instance you'll find that the broad experience available at B&W, through Mr. Tubes, is the means by which today's tubing problems are solved for tomorrow's applications. Call on Mr. Tubes, he's ready to help you.

For complete Croloy Creep Stress Data, send for Technical Data Card 102.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-4069(P)

control. Housed in dual bells, designed and tested for Class I, Group D hazardous locations, the entire unit takes up a floor space of about 4 by 6 ft. Periodic, automatic standardization is employed to compensate for ambient temperature and barometric fluctuations. Information from the unit can be telemetered any reasonable distance from a low impedance output designed to minimize possible stray pickup. Phillips Petroleum Co., Instrument Sales Div., Bartlesville, Okla.

Circle No. **62** *on Reply Card*

Synthetic Urea Process

. . . as developed by the company, featuring a full recycle with a high conversion per pass: *Bulletin F103* contains flow diagram of the process, and list of advantages. Chemical Construction Corp., 488 Madison Ave., New York 22, N.Y.

Circle No. **63** *on Reply Card*

Pump Fundamentals

. . . in a booklet explaining the operating principles of a centrifugal pump; including definition of terms used in calculations and a section in which typical pump problems are worked out. Ingersoll-Rand Co., Cameron Pump Dept., 11 Broadway, New York 4, N.Y.

Circle No. **64** *on Reply Card*

Motor Selection Data

. . . for choosing proper model for each application: *Bulletin B-2102* includes prices for protected and totally-enclosed, fan-cooled motors, and dimensions, as well as illustrations of different types. Reliance Electric & Engineering Co., 1076 Ivanhoe Road, Cleveland 10, Ohio.

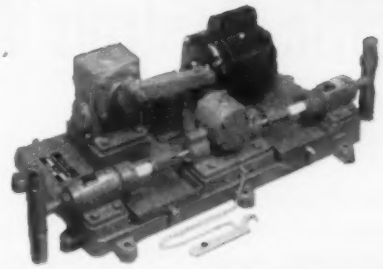
Circle No. **65** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of Petroleum Processing to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item. Then fill in the rest of the card and drop it in the mail. No postage is required.

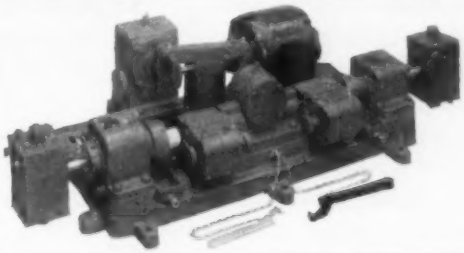
If you meter or proportion small volume flows...

THERE IS A HILLS-McCANNA "U" TYPE PUMP TO DO THE JOB



STANDARD 1, 2, 3 or 4 FEED UNITS

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



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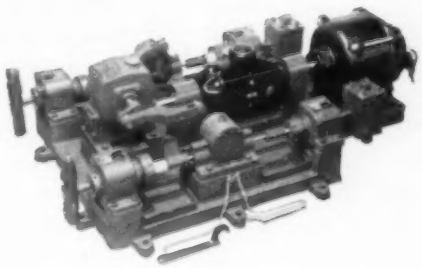
For handling materials that require heat or refrigeration, "U" Pumps can be supplied with either or both jacketed liquid ends and check valves.



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"U" Pumps can be furnished with a variable speed drive which permits varying capacity remotely or automatically when combined with the proper auxiliary equipment.

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(To obtain more data on advertised products see page 1620)

RESULTS OF AN INTELLECTUAL REVOLUTION . . .

"The Western Miracle" Continues . . . More Automatic Controls for Industry

Within recent weeks three new monthly technical magazines devoted to automatic control systems for industrial processes and machinery have offered the public their first issues. One of these is CONTROL ENGINEERING, a McGraw-Hill publication.

What has caused this surge of interest in the design and application of automatic control systems? What does it portend for the future of American industry? More important, what does it promise for the American standard of living, of which industry is and must be the servant? And what is the role of CONTROL ENGINEERING in this development? It is to those questions that this statement is addressed.

A New Intellectual Revolution

It is frequently asserted that we are now in the throes of a new industrial revolution. The revolution is described as the eliminating of wasteful applications of human labor to repetitive tasks through new technology which makes it possible to transfer those tasks to automatically controlled machinery.

It is perhaps more accurate, however, to say that we are the beneficiaries of a new intellectual revolution in the application of science to industry. This new intellectual revolution points the way toward giant strides in the continuing process of taking dull and laborious work off the backs and minds of men and transferring it to machines operating in large batteries under automatic control.

The practical engineering work required to convert this intellectual revolution into a full-scale industrial revolution, however, in large part still remains to be done. It is to this task that CONTROL ENGINEERING will be devoted. Its role is that of bridging the gap, in engineering and economic terms, between the new conceptions of automatic control of industrial processes and their practical workaday application. These conceptions run the full gamut from systems of control for automatic factories making heavy industrial products to highly personalized systems of automatic control to warn people when they are approaching the broiling point in sunning themselves at the beach or becoming too drowsy to drive their cars safely.

Enter the "Feed-Back" System

Enough work has been done to move these conceptions out of the realm of interesting dreams and into the realm of practical possibilities, and in some cases into the realm of practical realities. Crucial parts of this work were done during World War II when weapons were successfully equipped with "feed-back" systems

that automatically corrected mistakes made by the weapons in locating their targets.

The principle of the "feed-back" system is as ancient as the personal monitor that tells us not to run into each other as we walk along the street. It feeds back to our locomotion machinery the warning of a collision ahead. But the application of the principle to weapon control and then to more general machinery control required superlatively imaginative and skillful scientific development.

When a "feed-back" system that monitors an automatic process and keeps it lined up precisely is teamed up with a computing machine, capable of making lightning calculations that control both what goes into the process and what is done with the product, the horizons of automatic control become broad indeed. But in large part they still remain horizons. A vast range of practical engineering work remains to be done to realize anything like the full potential of automatic control of industrial processes and machinery.

More and Better Jobs

There are those who view the surge of interest in automatic control with alarm. They conjure up a situation in which automatic processes will at once expand the ranks of the unemployed and reduce many of those still working in industry to the status of robots or automatons.

A look at the record of the American economy — a record of amazing growth, steadily improving job opportunities and a constantly rising standard of living — demolishes the basis for such fears. The introduction of new and more efficient industrial machinery and processes obviously cannot be accomplished without creating some disturbance for some individuals and some companies. But consistently the longer range effect of such local and temporary disturbance has been more jobs and better jobs for Americans.

It is no accident that, while the proportion of industrial wage earners in our population is virtually the same as it was in 1920, the proportion of professional and salaried workers has doubled. The proportion of unskilled workers, furthermore, has dropped by half. This has been an essential part of a continuing process by which drudgery has been transferred to machines while the workers who formerly did the drudgery have been graduated to jobs calling for greater competence and providing better pay.

Higher Living Standard

A British historian, H. J. Hancock, has referred to this general process as "the Western miracle" — that of providing an ever higher and higher standard of living for more and more Americans. The key element in this miracle has been more and more reliance on power-driven machines to get the day's work done.

In the nature of the extremely complicated apparatus involved, full development of systems which have passed through the "think stage" into the status of practical possibilities will be a time-consuming process. It will also be a very exacting process, calling for a tremendous application of engineering skill and ingenuity. However, the engineers who are concentrating on this difficult, workaday phase of the development of apparatus for automatic control will be inspired by the knowledge that they are making a crucial contribution to technical progress which holds great promise of good for the American people.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

EDITORIALS . . .

Has the Finger Been Pointed?

FIGHTING smog is a costly proposition—as refiners in the Los Angeles area have found out. According to the results of a survey PETROLEUM PROCESSING made recently, and which is reported in this issue on pp. 1567-9, the refining companies in that area will have spent over $25,000,000 by next May in the battle against smog—part of it for research, but the big bulk for equipment installations.

Probably some of these equipment expenditures were wasted—as far as solving the smog problem goes. All the reports we get from Los Angeles are to the effect that smog is still as bad there as it ever was.

Some of the installations can be justified, of course, on the basis that any industrial plant should be a good neighbor and should prevent air pollution as much as possible and practical. But the point is that the Los Angeles refiners were forced to put them in because they were accused of being the biggest—if not the sole—cause of smog. It was a matter of being guilty until proved innocent—and for a long time they had not enough information to prove their innocence.

We have stated repeatedly on this page that smog is not a problem that will remain confined to Los Angeles. If you have a plant in a highly populated and industrialized area, you can probably look forward to a "smog" visitation sooner or later. As a case in point, New York City newspapers a few months ago carried headlines and stories about the "eye-burning smog" that was prevalent in "wide sections of the metropolitan area." One story reported that "officials at Elizabeth, N.J. [that's 15 miles from New York, and there's a nice big refinery there], after numerous complaints of runny, scratchy eyes, asked the State Health Dept. to make an investigation."

Don't sit back complacently and ignore the problem. Do what you can now to clean up the air-polluting emissions from your plant. Study the work being done on the causes of smog. Then, if and when the finger is pointed at you, you'll be in a better position than were the Los Angeles refiners to disprove your guilt—and you may escape being forced to install unnecessary "corrective" equipment.

New Tax Law Is No Handout

THERE'S an awful lot of merit in that newly-revised Federal tax law which Congress passed a few weeks ago. Details on some of the significant changes in it have been outlined for PETROLEUM PROCESSING by an accounting authority in this issue, pp. 1574-75.

In essence, one of the most important things this law does is help you by permitting your company to take bigger deductions for depreciation on its facilities during the first few years of service.

We think that's good. Even an editor—who isn't exactly an expert on such matters—can see that expansion in manufacturing facilities and greater research expenditures are essential to the continued vigorous growth of industry. We can also see that a company is going to be willing to invest more quickly if it has a better chance of getting its funds back more quickly, and that the sooner a company gets its capital investment back the sooner it will have those funds available for investment in still further facilities.

But don't let any of the anti-business people in your company get away with the rabble-rousing idea expressed by some elements that this faster depreciation represents a tax cut or a subsidy to big business by the government. It doesn't.

Make it clear that your company will still be able to deduct from income before taxes only the total amount of the investment—although it can be deducted more rapidly. Thus, during the early years of the plant's operation, your company will pay less in taxes, but during the later years, when deductions are lower, it'll pay more in taxes. The net result is that over the useful life of the plant essentially the same amount of taxes will be paid.

Take a Look at Your Markets

A CLUE as to why over-all refinery operations are so frequently out of line with supply and demand can be found in the studies which the College of Business Administration of the U. of Oklahoma has been making on the practices of oil companies in estimating future demand for their products.

In the course of its work the College's Bureau of Business Research mailed a questionnaire concerning product forecasting activities to 266 U.S. oil companies. Of the 75 usable replies, 42 reported they attempted to forecast demand for one or more refined products.

While the survey may not have been inclusive of all the companies refining and marketing petroleum products, those omitted would be the smaller concerns, least likely to engage in forecasting. It can also be assumed that the companies which do forecasting cooperated in the survey to a greater extent than other companies. In view of the survey returns, the conclusion seems justified that a very small number of refining concerns make any systematic effort to size up their future markets for gasoline and heating oils.

As might be expected, of the 20 largest companies, as measured by crude runs to stills, 18 submitted complete replies to the questionnaire. These 18 companies run perhaps up to 85% of the crude processed in the U.S. They are the firms who do the most to hold their plant operations in line with what their statisticians and economists tell them they can sell in the period ahead without contributing to unstable markets.

However, it does not take a very large percentage of overproduction to bring unsettled markets and create top-heavy product inventories in refiners' hands. If more refiners—including the smaller ones—did look ahead at what their product demand will likely be, the chances are their own crude runs would be held to their demand pattern and total refinery operations would come closer to remaining in balance.

Before You Order

YOUR LAB CHEMICAL REQUIREMENTS THIS MONTH...

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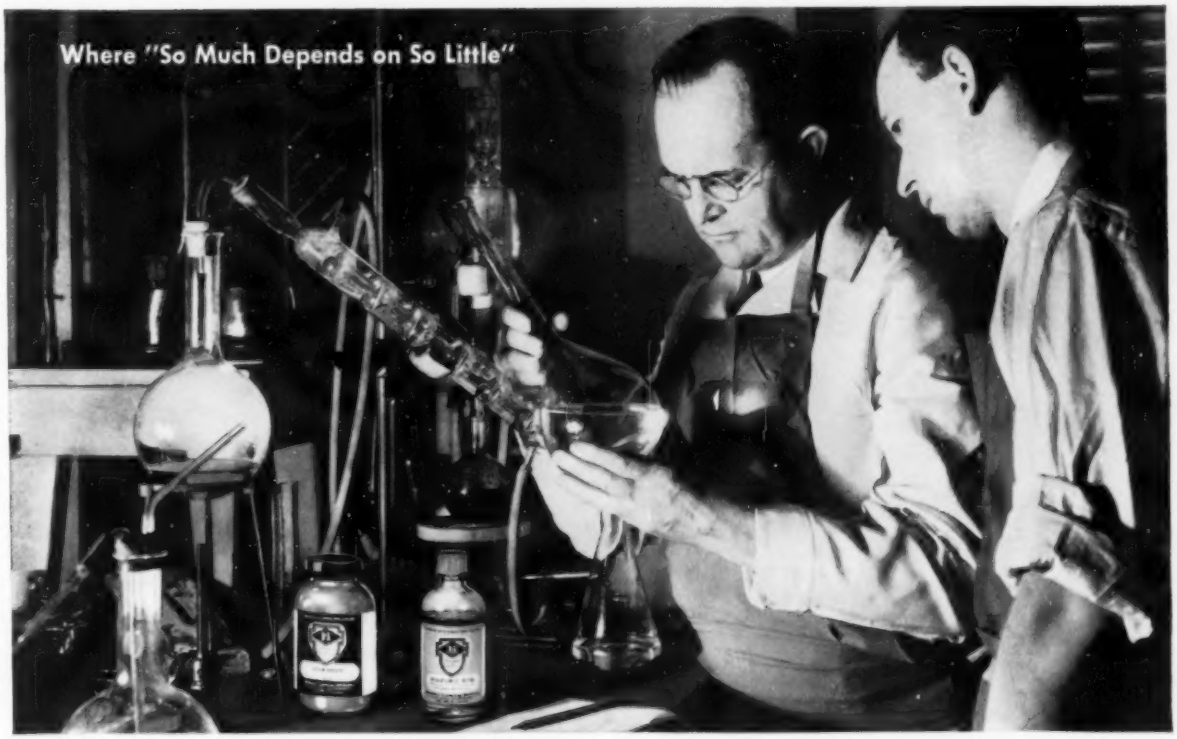

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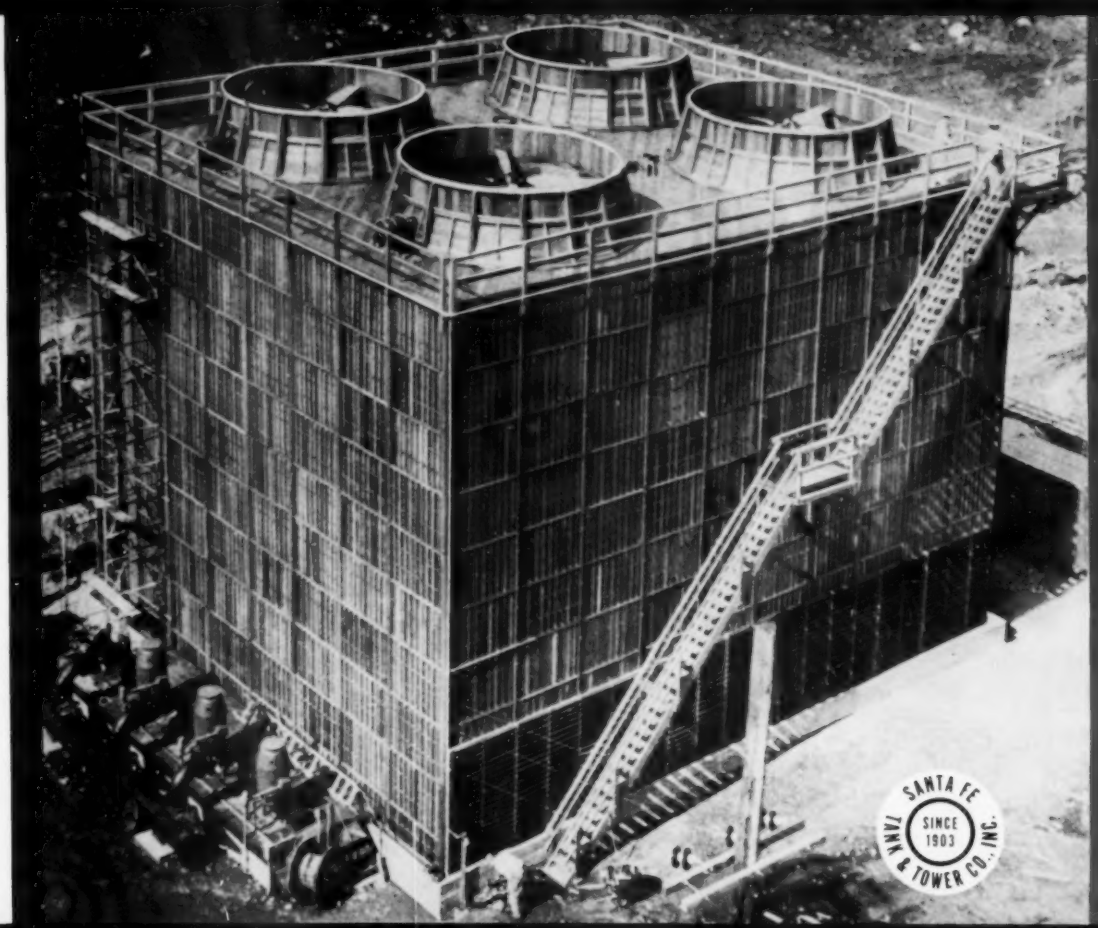

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